SEDAR

SouthEast Data, Assessment, and Review

Gulf of Mexico Gag Grouper
Stock Assessment Report

SECTION 2. Data Workshop

1. Introduction

1.1. Workshop Time and Place

The SEDAR 10 Data Workshop was held January 23 - 27 in Charleston, SC.

1.2. Terms of Reference

1. Characterize stock structure and develop a unit stock definition.
2. Tabulate available life history information (e.g., age, growth, natural mortality, discard mortality, reproductive characteristics); provide appropriate models to describe growth, maturation, and fecundity by age, sex, or length as applicable. Evaluate the adequacy of life-history information for conducting stock assessments and recommend life history information for use in population modeling.
3. Provide measures of population abundance that are appropriate for stock assessment. Document all programs used to develop indices, addressing program objectives, methods, coverage, sampling intensity, and other relevant characteristics. Consider fishery dependent and independent data sources; provide measures of abundance by appropriate strata (e.g., age, size, area, and fishery); provide measures of precision. Provide analyses evaluating the degree to which available indices adequately represent fishery and population conditions.
4. Provide commercial and recreational catch, including both landings and discard removals, in pounds and numbers. Evaluate the adequacy of available data for accurately characterizing harvest and discard by species and fishery sector. Provide length and age distributions if feasible.
5. Evaluate the adequacy of available data for estimating the impacts of past and current management actions.
6. Recommend assessment methods and models that are appropriate given the quality and scope of the data sets reviewed and management requirements.
7. Provide recommendations for future research and monitoring. Include specific guidance on sampling intensity and coverage where possible.
8. Prepare complete documentation of workshop actions and decisions (Section II. of the SEDAR assessment report) and final datasets in a format accessible to all participants. Report and datasets are due no later than March 31, 2006.

1.3. Workshop Participants

Workshop Panel

Pam Baker....................Environmental Defense
Luiz Barbieri....................GMFMC SSC/Fl FWCC
Carolyn Belcher....................SAFMC SSC/Univ. of Georgia
Alan Bianchi....................NCDMF
Craig Brown....................NMFS/SEFSC Miami, FL
Steve Brown....................FL FWCC
Ken Brennan....................NMFS/SEFSC Beaufort, NC
Mike Burton....................NMFS/SEFSC Beaufort, NC
Shannon Calay....................NMFS/SEFSC Miami, FL
Rob Cheshire....................NMFS/SEFSC Beaufort, NC
Brian Cheuvront....................SAFMC SSC/ NCDMF

Ching Ping Chih ....NMFS/SEFSC Miami, FL
William Collier ....NCDMF
Nancie Cummings ....NMFS/SEFSC Miami, FL
Guy Davenport...NMFS/SEFSC Miami, FL
Bob Dixon... NMFS/SEFSC Beaufort, NC
Karen Edwards...UNC
Mark Fisher...GMFMC FAP/TX PWD
Gary Fitzhugh ....NMFS/SEFSC Panama City, FL
David Gloeckner .... SEFSC/NMFS Beaufort, NC
Patrick Harris..SAFMC SSC/SCDNR
Jack Holland ....NCDMF
Walter Ingram...NMFS/SEFSC Pascagoula, MS
Nan Jenkins... SCDNR
Linda Lombardi-Carson..NMFS/SEFSC, Panama City, FL
Gus Loyal..GMFMC Advisory Panel
Vivian Matter...NMFS/SEFSC Miami, FL
Kevin McCarthy ....NMFS/SEFSC Miami, FL
Josh Sladek Nowlis..NMFS/SEFSC Miami, FL
Mauricio Ortiz ....NMFS/SEFSC Miami, FL
Patty Phares ....NMFS/SEFSC Miami, FL
Jennifer Potts .... NMFS/SEFSC Beaufort, NC
Marcel Reichert .... SCDNR
Fritz Rohde ....NCDMF
Jay Rooker...,..GMFMC FAP/TX A&M
Beverly Sauls ....FL FWCC
Jerry Scott ....NMFS/SEFSC Miami, FL
Kyle Shertzer .... NMFS/SEFSC Beaufort, NC
James Taylor..GMFMC Advisory Panel
Steve Turner...NMFS/SEFSC Miami, FL
Doug Vaughan .... NMFS/SEFSC Beaufort, NC
Robert Wiggers.. SCDNR
Erik Williams.. NMFS/SEFSC Beaufort, NC
David Wyanski .... SCDNR

Observers
Roy Williams .... GMFMC Member
David Cupka ....SAFMC Member
Pete Sheridan...NMFS/SEFSC Panama City

Staff
Steven Atran ....GMFMC
John Carmichael ....SEDAR
Rick DeVictor.. SAFMC
Kerry O'Malley .... SAFMC
Cynthia Morant...SAFMC/SEDAR
Gregg Waugh... SAFMC
Tyree Davis..NMFS/SEFSC Miami, FL

1.4. List of Data Workshop Working Papers

SEDAR10-DW1	Metadata for gag tagging data	McGovern, J., P. Harris
SEDAR10-DW2	Age, Length, and Growth of Gag from the NE Gulf of Mexico 1979-2005	Lombardi-Carlson, L. A., G. R. Fitzhugh, B. A. Fable, M. Ortiz, C. Gardner
SEDAR10-DW3	Update of gag reproductive parameters: Eastern Gulf of Mexico	Fitzhugh, G. R., H. M. Lyon, L. A. Collins, W. T. Walling, L. Lombardi Carlson
SEDAR10-DW4	Standardized Catch Rates of Gag from the United States headboat fishery in the Gulf of Mexico during 1986-2004	Brown, C. A.
SEDAR10-DW5	Description of MARMAP sampling program	Harris, P.
SEDAR10-DW6	Analysis of Preliminary Results for the Release of Satellite-Tracked Drifters over Gag Spawning Sites	Lesher, A. T., G. R. Sedberry
SEDAR10-DW7	Preliminary Notes on FL Gag Data and Trip Ticket Map	Brown, S.
SEDAR10-DW8	Review of Tagging Data for gag grouper from the Southeastern Gulf of Mexico region 1985-2005	Ortiz, M. K. Burns, J. Sprinkel
SEDAR10-DW9	Standardized catch rates for gag grouper from the MRFSS	Ortiz, M.
SEDAR10-DW10	Standardized catch rates for gag grouper from the United States Gulf of Mexico handline fishery during 1993-2004	McCarthy, K. J.
SEDAR10-DW11	Estimates of gag grouper discard by vessels with Federal Permits in the Gulf of Mexico	McCarthy, K. J.
SEDAR10-DW12	NOAA Fisheries Reef Fish Video Surveys: Yearly indices of abundance for Gag	Gledhill, C. T., G. W, Ingram, K. R. Rademacher, P. Felts, B. Trigg.
SEDAR10-DW-13	Report of a gag age workshop	Reichert, M., G. Fitzhugh, J. Potts
SEDAR10-DW-14	QA/QC procedures used for TIP online data	Gloeckner, D.
SEDAR10-DW-15	Analytical report on the age, growth, and reproductive biology of gag from the Southeastern United States	Reichert, M. , D. Wyanski
SEDAR10-DW-16	Gag history of management in the Gulf of Mexico	Rueter, J.
SEDAR10-DW-17	Overview of gag material in Draft SAFMC Snapper-Grouper Amendment 13B	Waugh, G.
SEDAR10-DW-18	Standardized catch rate indices for gag grouper landed by the US Gulf of Mexico longline fishery during 1993-2004	Cass-Calay, S. L.
SEDAR10-DW-19	Standardized catch rates of gag from the commercial handline fishery off the Southeastern United States	Shertzer, K.

SEDAR10-DW-20	Standardized catch rates of gag from the headboat fishery off the Southeastern United States	Cheshire, R., K. Shertzer
SEDAR10-DW-21	Recreational landings and length data summary for South Atlantic gag (DELETED FOLLOWING WORKSHOP DUE TO INCLUSION OF CONFIDENTIAL DATA)	Cheshire, R, and D. Vaughan
SEDAR10-DW-22	Commercial landings and length data summary for South Atlantic gag. (DELEDTED FOLLOWING WORKSHOP DUE TO INCLUSION OF CONFIDENTIAL DATA	Gloeckner, D., D. Vaughan
SEDAR10-DW-23	Effect of some variations in sampling practices on the length frequency distribution of gag groupers caught by commercial fisheries in the Gulf of Mexico	Chih, C-P
SEDAR10-DW-24	Estimation of species misidentification in the commercial landing data of gag groupers and black groupers in the Gulf of Mexico	Chih, C-P., S. Turner
SEDAR10-DW-25	Habitat use by juvenile gag in subtropical Charlotte Harbor, FL.	Casey, J. P., G. R. Poulakis, P. W. Stevens
SEDAR10-DW-26	Recreational survey data for gag and black grouper in the Gulf of Mexico.	Phares, P., V. Matter, S. Turner
SEDAR10-DW-27	Spatial distribution of headboat trips from the Florida Keys	Matter, V. M.
SEDAR10-DW-28	Species ID south Atlantic – ETA 1 week post workshop	Chih
SEDAR10-DW-29	Council Boundaries	anon
SEDAR10-DW-30	Annual indices of abundance for gag from Florida Estuaries	Igram, W., T. Macdonald, L. Barbieri
SEDAR10-DW-31	Age composition information South Atlantic	Potts, J.
Research Documents		
SEDAR10-RD01	Exegeses on Linear Models	Venables, W.N.
SEDAR10-RD02 1977	A reformulation of Linear Models J. Royal Stat. Soc. A 140(1):48-77	Nelder, J. A.
SEDAR10-RD03 1999	Stock identification of gag along the Southeast coast of the United States Mar. Biotechnol. 1, 137-146.	Chapman, R. W., Sedberry, G. R. , C. C. Koenig, B. M. Eleby
SEDAR10-RD04 2005	A tag and recapture study of gag off the Southeastern US Bull Mar Sci 76(1)47-59.	McGovern, J. C.,et al
SEDAR10-RD05 1983	Empirical use of longevity data to estimate mortality rates FishBull 82(1)898-903	Hoenig, J.M.
SEDAR10-RD06 2005	Bycatch, discard composition, and fate in the snapper grouper commercial fishery, North Carolina NCSU/CMAST Proj 04-FEG-08	Rudershaussen, P. J., A. Ng, A. Ng, J. A. Buckel

2. Life History

2.1. Mortality Estimates – Total, Natural, and Release

2.1.1. Juvenile (YOY)

Mortality rates of juvenile gag were examined in shallow seagrass beds located on the northwest coast of Florida using catch curve analysis (regression of CPUE over sampling period). Daily instantaneous mortality (Z) ranged from 0.0027 to 0.0032, suggesting that daily mortality was less than 1% per day at all sampling stations (Koenig and Coleman 1998). Similar to other early life estimates of mortality, early life estimates of Z may be affected by emigration or immigration from juvenile habitats. These juvenile Z values will be taken into account when analyzing data for age-varying M, such as the Lorenzen (1996) model.

2.1.2. Sub-adult/Adult

Maximum age of gag in Gulf of Mexico is 31 years (SEDAR10-DW2) while estimates in the South Atlantic range from 26 (SEDAR10-DW15) to 30 years (SEDAR10-DW31). Using this information, natural mortality (M) of gag was estimated using the regression model reported by Hoenig (1983) for teleosts: $\ln(M) = 1.46-1.01*\ln(t_{max})$. It should be noted that the Data Workshop (DW) did not use the alternative "rule of thumb" approach for estimating M from longevity ($M=2.98/t_{max}$, Quinn and Deriso 1999, Cadima 2003). Recent work by Hewitt and Hoenig (2005) recommend the regression model over the rule-of-thumb approach. Using Hoenig's regression approach, natural mortality of gag was slightly lower in the Gulf (M = 0.13) than the South Atlantic (M = 0.14-0.16). Natural mortality was also estimated using a variety of models based on von Bertalanffy growth or reproductive parameters (e.g., Jensen 1996). Using these alternative models, M ranged from 0.15-0.22 and 0.17-0.33 in the Gulf of Mexico and South Atlantic, respectively. Estimates of natural mortality recommended by the DW are consistent with recently published mortality data (e.g., McGovern et al. 2005) as well as those applied in the previous gag assessment.

Recommendations:

1.) Use a baseline estimate of 0.15 for the initial evaluations for both the Gulf of Mexico and South Atlantic.
2.) For sensitivity analysis, the DW recommended the following ranges of M: Gulf of Mexico (0.10 and 0.20) and South Atlantic (0.10 and 0.25). The upper range of M in the South Atlantic is higher due to estimates of M from models using the von Bertalanffy parameters.
3.) Following the DW, investigate age-varying M models and their appropriateness.

Estimates of total instantaneous mortality (Z) have been reported from recapture data and catch curves. McGovern et al. (2005) reported Z values of 0.38 (recapture data) and 0.40 (catch curves) for gag from the southeastern U.S. Using data in the

SEDAR10-DW2 document, the DW estimated Z values for a range of strong year classes or cohorts (1985 = 0.60, 1989 = 0.53, 1993 = 0.30, and 1996 = 0.52) in the Gulf of Mexico (based on individuals ~ 4-12 years). Catch curve estimates of Z ranged from 0.30-0.62 among individual cohorts. Combining all cohorts for the 4-12 year age interval, an overall Z of 0.52 was observed. A catch curve was also developed for gag 13-25 years, and Z (0.21) was markedly lower than the estimate for individuals in the 4-12 year age interval.

2.1.3. Release Mortality

A previous gag population assessment for the South Atlantic used release mortality rates of 20% and 50%. The first value was from surface observations of released fish on Headboat fishing trips, and the latter value was used because it was expected that mortality would be higher than what was observed at the surface (Robert Dixon, NMFS, Beaufort, NC, *pers. comm.*.; Potts and Manooch 1998). The 2001 Gulf of Mexico gag assessment used discard mortality rates of 20% for the recreational fishery and 30% for the commercial fishery based on different depths fished and an apparent increase in discard mortality rate with increasing depth (Turner et al. 2001). Recent work provides updated information on discard mortality in the South Atlantic and Gulf of Mexico. Discard mortality studies focusing on undersized gag utilized multiple techniques including observational indices (Rudershausen et al. 2005), tag release comparison (Burns et al. 2002; McGovern et al. 2005), and caging observations (Burns et al. 2002; Overton and Zabawski 2003).

A study by Rudershausen et al. (2005) reported pressure related effects, expressed as gastric distension and bleeding, on gag (n = 101) collected off North Carolina from depths ranging from 19-85 m (mean=29 m). Compared to five other species collected in the same study, gag exhibited the second highest rate of gastric distension (37.6%) and the highest occurrence of bleeding (16.8%). Of 29 gag released, all oriented and swam towards the bottom; only 5 were judged to swim in an erratic manner (condition 1 and 2; Patterson et al. 2000). However, gag with gastric distention or bleeding, if released, were expected to experience higher post-release mortality than predicted by the surface observations.

Improved estimates of post-release mortality were obtained through tag release and caging methods (Burns et al. 2002; Overton and Zabawski 2003; McGovern et al. 2005). Using these methods, mean mortality rates were estimated to be 21.2% for depths <35 m (Overton and Zabawski 2003), 23% over a variety of depths (McGovern et al. 2005), and 100% for depths >50 m (Wilson and Burns 1996).

Release mortality rates displayed a positive relationship (logistic regression) with depth, increasing from 14.2% at 15 m to 94.8% at 95 m with a 50% mortality rate at 45.5 m (McGovern et al. 2005). Burns et al. (2002) combined tag release comparison and caging observation methods to estimate discard mortality rate and found 50% mortality at a similar depth (47 m). The depth at 50% swimbladder rupture (47 m) was also similar to that for 50% mortality (Burns et al. 2002).

Vented gag showed increased survivorship compared to non-vented gag based on recapture data with all depths grouped. When recapture rates were stratified by depth, only the shallowest depth (0-12.2 m) had a significant difference between the vented and non-vented gag (Burns et al. 2002).

At depths less than 20 fm (37 m, inner shelf) where survival upon release is likely to be relatively high (about 50% or better survival with proper handling), ages and sizes of gag landed are consistently (in Gulf and SA) more truncated than at deeper depths (Figures 2.1-2.3). At depths greater than 40 fm, (73 m, outer shelf and upper slope) release mortality is likely to be quite high with little to no chance for survival. However, numbers of gag (in the compiled age-structure data) declines in this deepest zone compared to shallower depths; sizes and ages tend to increase compared to shallower depths (thus fewer potential discards, especially for the Gulf, Figure 3) and there appears to be a switch to landings dominated by long-line gear in the Gulf (Figure 2.4). Estimates of release mortality between the depths of 20-40 fm (37- 73 m, mid to outer shelf) are likely to be of *greatest concern* because this is the zone in which evident increases in release mortality (>50%) coincides with increasing depth. Also, compiled data from the Gulf and SA show that high numbers of gag from very broad age and size ranges can be harvested at 20-40 fm (Figures 2.1-2.3); thus undersized gag will be taken and will be at significant risk of mortality upon release. These suppositions are based upon example depth data accompanying biological samples. Conclusions may change when more complete landings data (by depth if available) are reviewed. The DW recognized that functional relationships of depth and release mortality potentially offers improved information over the use of simple point estimates of mortality representing broad depth intervals.

Recommendation:
The DW recommended further investigation into the practicality of applying depth-mortality functions as the assessment proceeds. Since discard mortality functions by depth were very similar between the Gulf of Mexico (Burns et al. 2002) and the South Atlantic (McGovern et al. 2005), a single function may apply to both unit stocks. Workgroup discussions then centered on the issue of whether it may be feasible to use age/length data and depths associated with discards or perhaps depth trends by fishery sector to estimate release mortality using these functions. Analysis is underway and will be made available to the assessment group prior to the Assessment Workshop. If a single function cannot be derived, then the group will further discuss options for release mortality values based on fishery sector.

2.2 Age Data

2.2.1. Age Structure Samples

Three sets of age data were brought to the DW. Contributors included NMFS Panama City with data from the Gulf of Mexico commercial and recreational fisheries, NMFS Beaufort with data from the U.S. South Atlantic commercial and recreational fisheries, and SCDNR/MARMAP with data from the U.S. South Atlantic commercial and recreational fisheries and fishery-independent surveys, combining for a total of about 22,000 gag age estimates. Brief characterization of sampling and related issues follows:

Gulf of Mexico (SEDAR10-DW02)

Issues:
1.) Pre-1998 samples sizes of long-line collected otoliths were low compared to recent years.
2.) Throughout the time series the recreational industry, and in particular the private sector, was not well represented (n<200, 1991-2005). 3.) Fishery independent samples were also not well represented throughout the time series (n<500, 1991-2005).

Recommendations:
1.) Conduct further review of current sampling methodologies by sector, including detailed comparison of length data from otolith samples and from more expansive port-based length sampling (via TIP; see SEDAR10-DW24).
2.) Bring increased attention to the need for strategies to improve port sampling (representation of fishery sectors and random sampling)
3.) Increase the sampling of the recreational sector for biological samples throughout the docks and ports of Florida's west coast.
4.) Continue support of fishery-independent surveys including all gears (hand-line, long-line, and trap) throughout the west Florida shelf.
5.) Recognize that gag landings may be increasing elsewhere in the Gulf and bring increased attention to sampling the northern and western Gulf regions.

South Atlantic (SEDAR10-DW15, SEDAR10-DW31)

Issues:
Data collected by NMFS Beaufort was dominated by samples from the east coast of Florida from two major time periods (1976-1986; 1992-2004). The earlier time period collected mainly from the recreational sector whereas more recent years were from the commercial sector. Data were collected by SC-DNR throughout the region (NC through central FL), with most samples collected off the Carolinas. Most of these samples originated from the commercial sector during an intensive sampling period approximately every 10 years (1977-82, 1994-95, and 2004-05). In 2004-2005, SC-DNR employed commercial fishers under a special permit to collect all sizes of fish (including undersized fish), and collections were made throughout the closed season.

The assignment of an otolith edge type, which allows estimates of annual (calendar) ages and biological (fractional) ages, has changed at SCDNR. Edge type are available for all aged fish collected after 1995, some edge types from samples collected in 1994-95 are available, and all samples collected after 1995 contain edge type information. This restricts the combination of data pre-1996.

Recommendations:
1.) The DW recommended combining the datasets from NMFS Beaufort and SCDNR to increase sample size, improve temporal coverage and growth pattern analysis.
2.) Continue with annual sampling for age structure with increased attention to representative sampling as above.
3.) SCDNR to include additional edge information based on available increment measurements to allow for age advancement, this will result in additional age data for 495 fish collected in 1976-1982, and for 763 fish collected in 1994-95 (this was completed post-DW and made available February16, 2006).
4.) SCDNR may be able to re-examine preparations to add edge information to allow for age advancement however, this will entail additional effort. (Data will be made available by February 17, 2006.)

2.2.2. Age Reader Precision

In September 2005, representatives of these three principal gag aging labs held a workshop to compare otolith interpretation, methods, and readings of gag otoliths for age estimates. Workshop results indicated that all labs use comparable procedures and methods for otolith examination. Furthermore, there was a high level of agreement and precision among readers from all labs and there was no appreciable reader bias evident from reader contrasts (SEDAR10-DW13).

Issue:
Differences in otolith interpretations and methodologies in the past have led, in some instances, to incompatible datasets.

Recommendation:
To continue exchanges of calibration otoliths sets and age workshops among state and federal agencies, and universities to continue improvements of data comparability and quality control.

2.2.3. Age Patterns

Gag year-class trends have been apparent for the Gulf of Mexico and the South Atlantic due to the ease of aging gag and the availability of a continuous series of age structure sampling from 1991 to 2005 from the Gulf, and 1981 to 1986 and 1999 to 2003 from the Atlantic. Strong year classes evident in the Gulf of Mexico were 1985, 1989, 1993, 1996, 1999, and possibly 2000. Strong year classes in the U.S. South Atlantic were 1974, 1978, 1981, 1990, 1994 and 1996. The available overlapping years for the Gulf and South Atlantic revealed similar age progression and a relatively strong 1996 year class in both regions. This further suggests that annual recruitment trends may be similar in both regions. The DW recommends that age structure sampling continue on an annual basis for both regions.

Contributors of the three age data sets found similar age ranges – 1-31 years, 0-30 years and 1-26 years, (NMFS Panama City, NMFS Beaufort, and

SCDNR/MARMAP, respectively) – but did note differences in size-at-age and different maximum size between the Gulf of Mexico and the U.S. South Atlantic (SEDAR10-DW2, SEDAR10-DW15, SEDAR10-DW31).

2.3. Growth

There have been several growth studies on gag in the Gulf of Mexico and South Atlantic (see citations within SEDAR10-DW2, SEDAR10-DW15, and SEDAR10-DW31). The updated data sets provided increased sample sizes for improved temporal coverage and contrasts. Growth models can be influenced by the use of size-biased samples, for example, due to minimum size-limits affecting fishery-dependent sampling. Thus, a modified von Bertalanffy growth model accounting for size limited data was used for the Gulf of Mexico (1991-2005, n=16,147) and South Atlantic (1976-2005, n=5,734; Diaz et al. 2004). Model fits used area, sector and temporal specific size-limits (GOM: 1990-2000 all sectors 20 inches, 2000-2005 recreational 22 inches, 2000-2005 commercial 24 inches; SA 1992-1998 all sectors 20 inches, 1999-2005 all sectors 24 inches).

The model was fit to observed lengths and fractional ages. Gag data from the entire time series were fit to the modified von Bertalanffy growth model (TL mm), separately by area (GOM, SA), to obtain population growth parameters for each area. The modified growth model resulted in an asymptotic length within the range of observed lengths (GOM: L_∞=1310 mm, TL range 245-1384 mm; SA L_∞=1051 mm, TL range 215-1300 mm), growth coefficients (GOM: $k = 0.14\ yr^{-1}$; SA: $k=0.24\ yr^{-1}$) and predicted t_o close to zero (GOM: t_o =-0.37 yr; SA: t_o =-0.48 yr).

Issues:
SCDNR analysis of size-at-age data and von Bertalanffy growth among the three periods (1979-82, 1994-95, and 2004-05) using increment counts and non-weighted data indicated possible temporal patterns in growth (SEDAR10-DW15, SEDAR10-DW31). However, data from NMFS-Beaufort did not show similar patterns.

Recommendations:
Analysis of combined South Atlantic datasets (SCDNR, NMFS Beaufort) for size-at-age and growth with various versions of the von Bertalanffy growth model using unweighted and weighted data will be completed prior to assessment workshop. (Data analysis will be made available by the end of February 2006.)

2.4. Reproduction

There have been several investigations of the reproductive biology of the gag in the U.S. South Atlantic and eastern Gulf of Mexico. Studies have addressed reproductive seasonality, spawning depth, sex ratio, sexual maturity, sexual transition (from female to male), aspects of the mating system, principal spawning habitats and regions, behavior, coloration, reproductive endocrinology, fecundity and spawning frequency (see citations within SEDAR10-DW3 and SEDAR10-DW15). The review below presents a summary of gag reproductive parameters that are most relevant for stock assessment. Topics are discussed jointly for U.S. South Atlantic and eastern Gulf of Mexico.

2.4.1. Spawning Seasonality

Spawning season in the South Atlantic was estimated to extend from mid-January to early May (with a peak in March-April), corresponding to a 114 d spawning duration (SEDAR10-DW15). In the eastern Gulf of Mexico the spawning season was estimated to extend from late January to mid-April (with a peak in March), corresponding to a 91 d spawning duration (SEDAR10-DW3). For both areas, delineation of the spawning season was based on the presence of females in spawning condition (i.e., ovaries containing hydrated oocytes or postovulatory follicles).

2.4.2. Sexual Maturity

Gag are known to be protogynous hermaphrodites (female first, changing to male later in life). Consequently, sexual maturity is reported for females only. Male sexual maturity is being addressed under "Sexual Transition" below.

Although data for the South Atlantic (mostly fishery-dependent) suggested temporal changes in size- and age-at-maturity (Table 2.1.; SEDAR10-DW15), discussion by the Life History Working Group could not resolve the issue of whether these changes were real or a reflection of temporal changes in size limits. Data from the Gulf of Mexico (collected during 1991-2002; SEDAR10-DW3) indicated no temporal changes in size- and age-at-maturity for gag. Size at maturity for Gulf of Mexico gag was 585 mm TL corresponding to an age-at-maturity of 3.7 yrs. These estimates are similar to, or perhaps slightly smaller than, size at maturity reported previously in US waters of the Gulf of Mexico.

Recommendations for South Atlantic:

1.) Provide an estimate of length and age at 50% maturity (L_{50} and A_{50}) for the entire time period (i.e., mean and variance for the data pooled over years). The pooled length and age at 50% maturity estimates are 648 mm TL (3.0 yr). Also, further analysis of data using a modified logistic model that takes into account minimum size regulations will be done following this workshop.

2.) Provide estimates of L_{50} and A_{50} for each of the time periods sampled. Estimates for the 3 separate time periods can be found in SEDAR10-DW15, as well as parameter estimates for each period and periods combined.

2.4.3. Sexual Transition

Similar to what we observed for "Sexual Maturity" data for the South Atlantic showed evidence of temporal change in size and age at sexual transition for gag. Histological examination of 1,128 sexually mature gag collected during 2004-05 revealed that the percentage of males and transitionals increased from 5.5% in 1994-95 (see McGovern et al. 1998, cited in SEDAR10-DW15) to 8.2%. The current percentage of males and transitionals is still much lower than the revised estimate of 19.4% for samples collected during 1977-82; McGovern et al. (1998) reported 21.1% males and transitionals in the 1976-82 samples. However, similar to the approach we took for "Sexual Maturity", we are providing a single estimate for size and age at transition: 1,025 mm TL for length at 50% transition and 10.5 yr for age at 50% transition. Estimates for the 3 separate time periods can be found in SEDAR10-DW15.

Data for the Gulf of Mexico (collected during 1991-2002, see SEDAR10-DW3) showed no evidence of temporal changes in size and age at transition (compared to Hood & Schlieder's data from 1977-80, cited in SEDAR10-DW3). Additionally, the histological and visual analyses of female size at transition to male (i.e., visual identification of "copperbellies") yielded very similar results. Based on histological criteria, size at 50% transition was 1100 mm TL, and based upon visual pigmentation size at 50% transition was 1085 mm TL. In both analyses, transition appeared to begin after 800 mm TL and nearly all gag had undergone transition upon reaching 1300 mm TL. Age at 50% transition was 10.8 years. Transition to "copperbelly" pigmentation began at age 7 and nearly all fish were pigmented after about 15 years of age.

2.4.4. Batch Fecundity

Very consistent parameter estimates were found for Gulf and South Atlantic stocks.

<u>South Atlantic</u>: Batch fecundity as a function of total length did not differ between the three time intervals (Jan-Feb, Mar, and Apr-May), as indicated by the lack of differences in slopes (F=0.05; P=0.956; df=2) and intercepts (F=2.62; P=0.078; df=2). Given the similarity of the equations, data from all time intervals were combined. Linear regression parameters for the relationships between BF and fish size and age can be found in SEDAR10-DW15.

<u>Gulf of Mexico</u>: Batch fecundity (BF) increased with age and length of females, ranging from 60 thousand to 1.7 million ova per batch with a mean of 422 thousand ova (sd = 295 thousand). Variation in batch fecundity was generally high among age and size classes but the variation explained by linear fits of batch fecundity regressed on age and size were similar ($r^2 = 0.30$ and 0.34 respectively). As is common among fishes, the batch fecundity relationship was best predicted by regression with (ovary free) body weight ($r^2 = 0.53$). This is similar to results given in Collins et al. (1998) but expands the sample size of hydrated females. Linear regression parameters for the relationships between BF and fish size and age can be found in SEDAR10-DW3.

2.4.5. Spawning Frequency

<u>South Atlantic</u>: for a spawning season of 114 days the spawning frequency was estimated to be 1 spawn every 2.5 days (corresponding to 38 spawning events per season). See SEDAR10-DW15.
<u>Gulf of Mexico</u>: for a spawning season of 91 days the spawning frequency was estimated to be 1 spawn every 3.7-4.0 days (corresponding to 23-25 spawning events per season). See SEDAR10-DW3.

Recommendation:

Given that there is little evidence in both regions for an age effect on spawning frequency in both regions, annual fecundity at age would merely be the product of the expected number of spawns per female per season multiplied by batch fecundity at age.

2.5. Movements and migrations

The DW reviewed the results of two relatively large gag tagging studies. The objective was to gauge the degree of exchange between Atlantic and Gulf stock units. Approximately 6,500 gag were tagged primarily on the west Florida shelf, resulting in over 600 recaptures exhibiting limited movements (80% within a 9 km radius; SEDAR10-DW8). No movement was detected between the west Florida shelf and Atlantic stock units in this study. Most of these fish were recreational tag and recaptures and predominately showed ontogenetic movements from coastal to deeper waters of the shelf. In contrast, a South Atlantic tagging study (3,876 tags, 435 recaptures) reports a much higher proportion of fish moving a greater distance (23% over 185 km), primarily from the Carolinas towards the south to the Florida east coast (McGovern et al. 2005). There were several fish tagged in the South Atlantic that were recaptured from the Keys to the west Florida shelf.

Depth of tagging and size of fish appears to explain the different results from these two studies. In the Gulf tagging study, the modal size of tagged gag was approximately 400 mm. In the South Atlantic study, fish were tagged primarily from commercial boats across a broad depth range; fish were notably larger, ranging in mean size from 578-832 mm TL across 10-m depth categories. Mean distance moved was significantly greater for gag tagged in the 21-40 m depth range. It has also been reported that events such as hurricanes may cause large scale movements in shallow water groupers including gag. Gag were reported to be more abundant in Mississippi, Alabama and NW Florida after Hurricane Eloise in 1985 (Franks 2005).

In general, information suggests an ontogenetic movement to deeper waters; smaller gag (late juvenile to early adult) exhibit relatively high site fidelity with localized movements on the order of a few km. Gag then make larger along-shelf movements upon reaching depths of the mid to outer shelf (mature adults). There is some evidence that upon reaching older ages and outer shelf depths, associated with spawning habitats, gag again exhibit higher site fidelity (Coleman et al. 1996). Fish tagged and recaptured at the deepest depths (41-80 m) did not exhibit movements as large as those tagged at inner to mid-shelf depths less than 40 m (McGovern et al. 2005). Also, ongoing work suggests copperbelly gag tagged in spawning areas exhibit relatively high site fidelity (Koenig pers.comm.)

Recommendation:
Current data are inconclusive as to whether stock transfer or exchange is taking place between the US South Atlantic and the Gulf of Mexico. Therefore, no rate of migration, stock transfer or exchange should be implemented into the assessment models, and council boundaries should rule as the dividing line of the two stocks.

2.6. Stock definition and recommendations for research

Gag has been managed as separate Atlantic and Gulf stock units, and the SEDAR workshop panel was instructed by the SAFMC and GMFMC to continue with the two US management units in SEDAR 10. However, it was acknowledged that this may change in future assessments. The DW discussed stock identification issues, acknowledging work underway, and made recommendations for further research.

2.6.1 .Otolith Chemistry

Chemical signatures in otoliths have been used recently to discriminate gag from different nursery habitats. Hanson et al. (2004) demonstrated that chemical signatures in otoliths of gag could be used to classify juveniles from four nursery areas along the west coast of Florida (note: classification success ranged 66-100%). Results indicate the approach has promise for determining population structure and the relative contribution of gag from different nurseries. To date, the DW is not aware of reports characterizing chemical signatures in the otoliths of gag from the South Atlantic. If otolith signatures from the Gulf of Mexico and South Atlantic nurseries differ, these natural markers will provide a means of predicting the nursery origin of sub-adult and adult gag (retrospective determination based on quantifying material in the otolith core of sub-adults and adults, which corresponds to the nursery period). In addition, estimates of nursery origin could also be used to characterize population structure and connectivity of the two stocks. The DW recommends continued research on the use of otolith chemistry to evaluate the population structure of gag.

2.6.2. Population genetics

Genetic studies can provide both long-term and short-term estimates of connectivity among regional populations of Gag. Previous studies (Chapman et al 1999) exhibited evidence for population structure among different regions of the Gulf coast and Atlantic coast (a noteworthy result considering the high dispersal potential associated with this species), but significant departures from Hardy-Weinberg equilibrium within these sample groups. These departures from what is considered to be a neutral state assumption could be caused by many different processes such as high variance in reproductive success in individuals from year-to-year or regionally differential reproductive success in a structured population. Research underway addresses these questions and others associated with spatial and temporal population structure and their relationship to dispersal patterns, reproductive success, and effective population size (N. Jue, Florida State University). A recently funded Sea Grant proposal in South Carolina (Erik Sotka – PI, College of Charleston) will compare genetics of spawning gag captured in 2005 by commercial fishermen (sampled by MARMAP at SCDNR) to juveniles collected in North Carolina and South Carolina in subsequent months to determine the source of recruits, especially to North Carolina sounds. The DW recognizes the value of this research and that this type of genetics work can provide key insight into patterns in gag population structure. The DW further highly recommends every opportunity be taken to add Mexican (Campeche) samples to this analysis as these methods can be most informative in divining patterns of gene flow and population connectivity.

2.6.3. Demographic comparisons

Comparing estimates of growth, maturity, and sex-transition between Gulf and Atlantic management units provides inferences for stock connectivity. However, the DW recognized that subtle differences in methods of sampling, laboratory preparation and parameter estimation can obscure biological differences. The DW recognized that there have been recent workshops with productive outcomes on aging and reproductive assessments, targeting gag and similar species, and recommends that such workshops continue to be undertaken to eliminate potential methodological differences. The DW suggests that it may be particularly valuable to convene a workshop to address the potential non-random and non-representative sampling that hampers collection of small numbers of biological samples (relative to numbers of fish landed) which in turn are used for parameter estimates.

2.6.4. Age structure patterns

Gag year-class trends have been apparent for the Gulf of Mexico due to the ease of aging gag and the availability of a continuous series of age structure sampling from 1991 to 2005. The DW recommends that age structure sampling continue on an annual basis in the Gulf. Availability of age data in the South Atlantic is more episodic. The available overlapping years for the Gulf and South Atlantic revealed similar age progression and a relatively strong 1996 year class in both regions. This further suggests that annual recruitment trends are similar between regions. The DW recommends that long-term continuous monitoring of age structure be undertaken in the South Atlantic to test this hypothesis.

2.6.5. Larval transport and connectivity

It has been hypothesized that there are pathways for larval connectivity and transport from the Gulf to the Atlantic (Powles 1977, Fitzhugh et al. 2005). Exploration using a wind-driven 2-d transport model further supported this hypothesis but was unable to account for cross-shelf transport. In addition, there may be larval connectivity between the southern Gulf of Mexico (Campeche) and the west Florida shelf (Fitzhugh et al. 2005). The DW is aware that oceanographic modeling efforts are advancing (3-d models),and recommends that larval transport and modeling efforts associated with development of an Integrated Coastal Ocean Observing System (ICOOS) is further supported.

2.6.6. Tagging

Tagging studies are needed to: 1) clarify the extent of movement between the Gulf and SA regions and within region, and 2) aid further development of age-specific estimates of depth-related mortality in the Gulf region. In the SA region, most of the tagging effort has been off South Carolina. Therefore, we recommend that additional tagging be completed off the east coast of Florida to examine the extent of northerly and southerly movements. In the Gulf region, the bulk of the tagging targeted juveniles and young adults in coastal areas, therefore we recommend that tagging effort be extended to the middle and outer shelf, perhaps with the assistance of cooperating commercial fishers, for the purpose of tagging adult gag. The DW recommends that future tagging studies should be done in a more coordinated manner between researchers in the Gulf and SA regions, particularly with respect to gear, fish size, and depth.

2.7. Meristic Conversions

Gulf of Mexico: Meristic relationships were calculated for gag caught in the Gulf of Mexico for length types (total and fork) and body weights (whole and gutted), (Table 2.2). Coefficients of determination were high for linear (length) and nonlinear (weight) regressions (r^2>0.96).

South Atlantic: Various fishery independent and dependent data sets were used to develop relationships among whole weight (WW), gutted weight (GW), total length (TL), fork length (FL), and standard length (SL). When relating among lengths or among weight no-intercept linear regressions were used (Table 2.3). A linearized regression (ln-ln) was used to relate whole weight to various length measurements (Table 4). Note that when retransforming back to arithmetic space from logarithmic space, a bias correction is necessary based on the mean squared error (MSE) from the regression (Beauchamp and Olson 1973, Sprugel 1983). Estimates for whole weight (WW) at length (L) are obtained from:

$$WW = \exp(\text{Intercept} + MSE/2 + \text{Slope}*\ln(L)).$$

If we let,

$$a = \exp(\text{Intercept} + MSE/2),$$

then

$$WW = a\ L^b.$$

These regressions were originally done by source for the South Atlantic, and ultimately summarized for the region as presented in the tables referenced. Fishery-independent data included whole weight, gutted weight, total length, fork length, and standard length from the SC DNR MARMAP program. These same data (less the gutted weight) were also available from FL FWCC. In recent years, the Headboat program has measured occasional fork lengths along with total lengths. Fishery dependent data for whole weight and lengths were available from headboat (TL), MRFSS (FL), and TIP (TL) for both coasts. All weights shown are in kilograms and all lengths are in millimeters.

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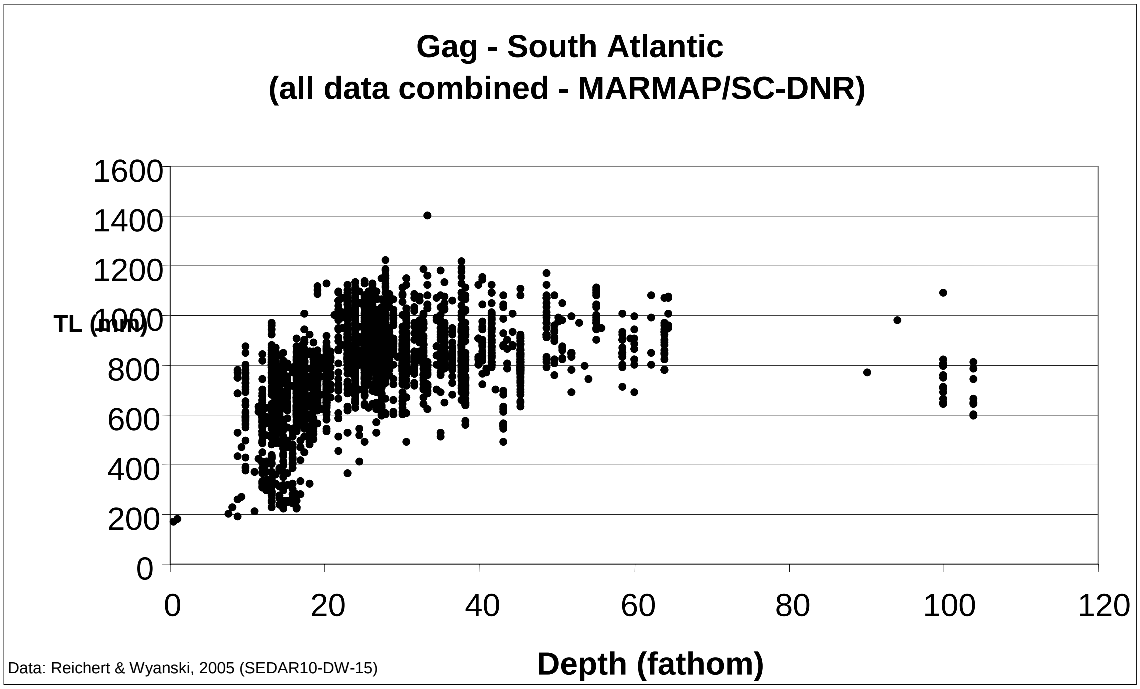


Figure 2.1. Gag total length (mm) plotted with depth (fm) for the South Atlantic. All gears were combined (fishery-independent and dependent) thus accounting for occurrences of undersized fish (below about 500 mm TL).

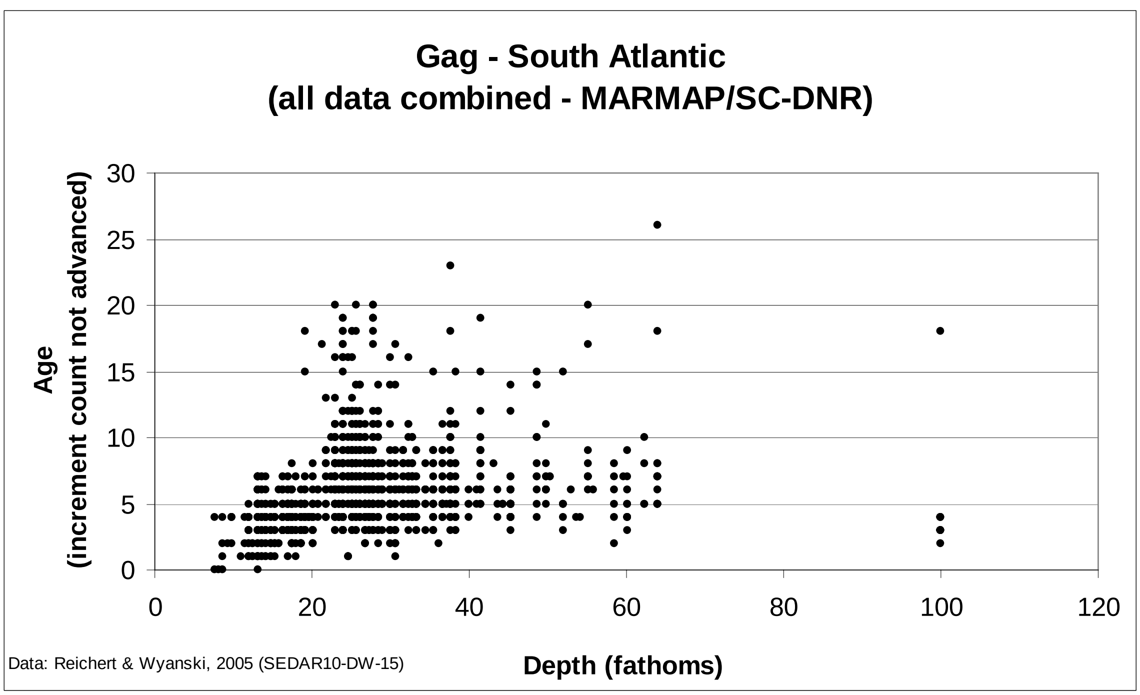


Figure 2.2. Gag age (increment count) plotted with depth (fm) for the South Atlantic. All gears combined (fishery-independent and dependent)

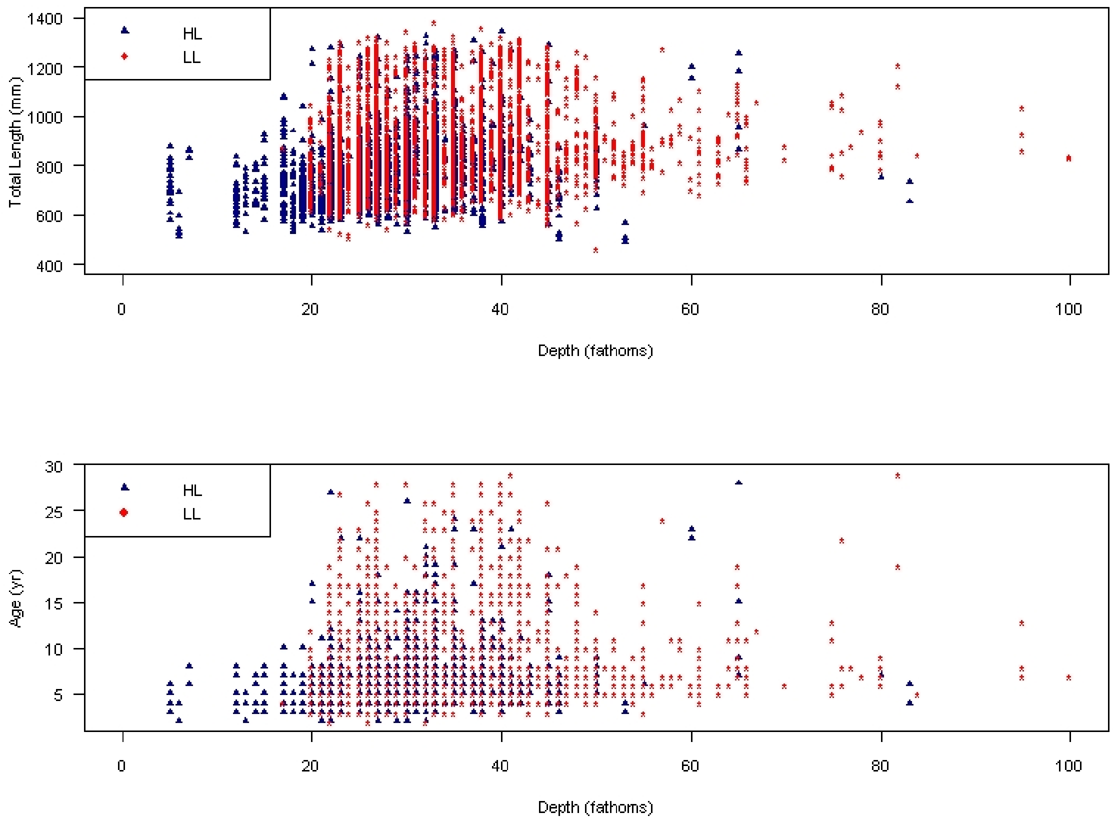


Figure 2.3. Age and length plotted with depth (fm) for the Gulf of Mexico for long-line (LL) and handline (HL) fisheries.

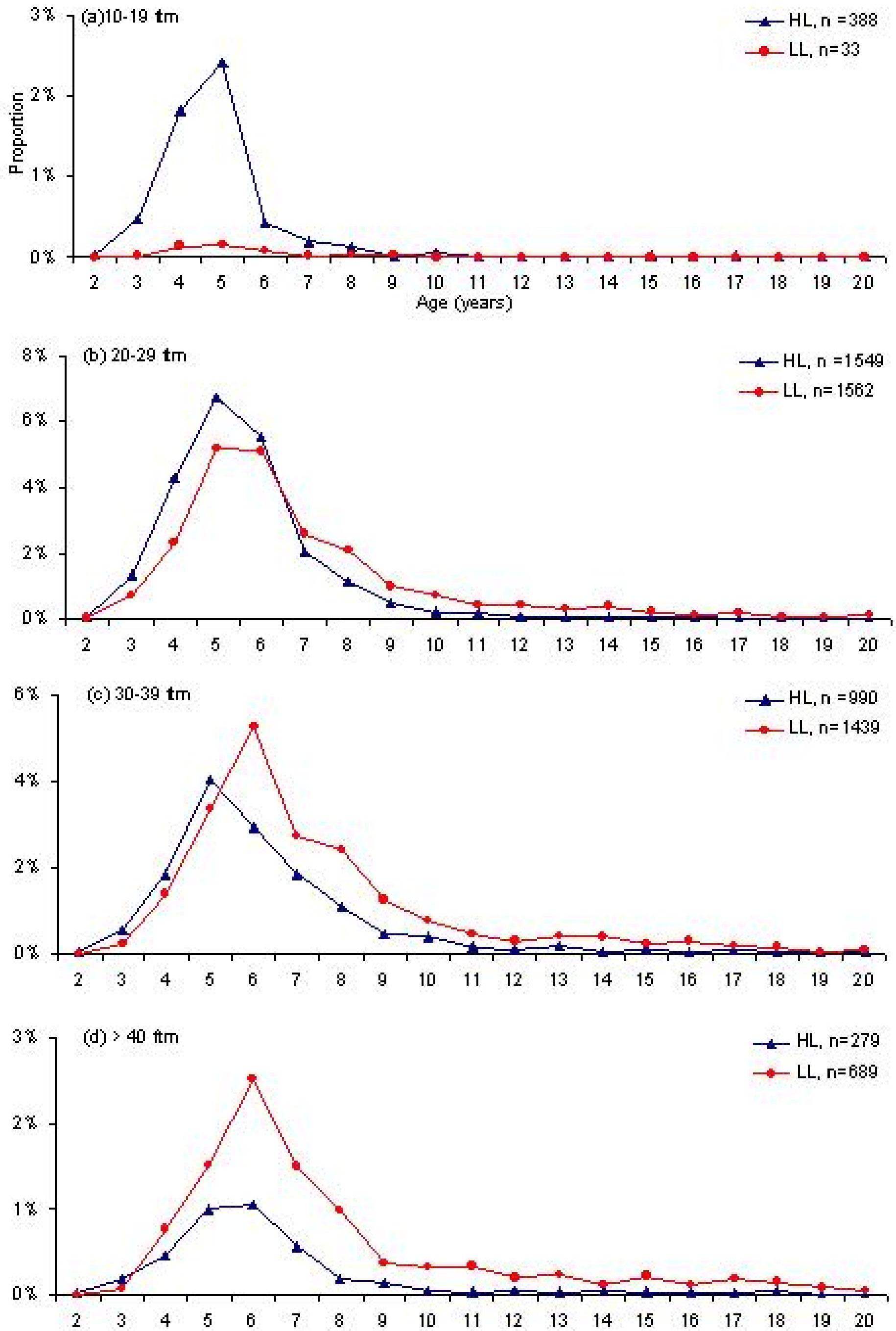


Figure 2.4. Age data proportioned to the depth (fm) fished and commercial gear type. Depth categories in 10-fm bins. Scales on y-axis vary.

Table 2.1. Gag reproductive biology analysis – probit analysis – from the South Atlantic (SCDNR data – SEDAR10-DW15).

Analysis	Period	Cumul. Distrib.	N	Intercept	Standard Error	Independent variable	Standard Error
Age (count) at sex transition	1977-82	Normal	322	-3.37	0.41	0.287	0.047
	1994-95	Normal	1508	-4.26	1.03	0.406	0.129
	2004-05	Normal	1048	-4.60	0.28	0.474	0.036
	all	Normal	2878	-4.16	0.49	0.398	0.061
Total length at sex transition	1977-82	Logistic	501	-22.94	2.17	0.023	0.002
	1994-95	Normal	3836	-13.93	0.89	0.014	0.001
	2004-05	Logistic	1004	-29.45	3.82	0.028	0.004
	all	Logistic	5341	-19.29	0.60	0.018	0.001
Age (count) at maturity	1977-82	Logistic	329	-8.34	1.37	2.239	0.334
	1994-95	Logistic	1439	-6.42	0.77	2.442	0.227
	2004-05	Gompertz	1276	-5.41	0.48	1.594	0.136
	all	Logistic	3044	-7.68	0.81	2.529	0.240
Total length at maturity	1977-82	Gompertz	472	-9.60	1.37	0.015	0.002
	1994-95	Gompertz	3679	-12.68	1.01	0.020	0.002
	2004-05	Logistic	1239	-32.37	2.37	0.048	0.004
	all	Logistic	5390	-24.91	2.19	0.038	0.003

Table 2.2. Meristic regressions for gag from the Gulf of Mexico (1991-2005). Refer to SEDAR-10-DW-2, for details.

Gulf of Mexico

Conversion and Units	Equation	Sample Size	r^2 values	Data Ranges
FL (mm) to TL (mm)	TL = 1.03 * FL – 0.68	4999	0.99	TL (mm): 245 – 1360 FL (mm): 238 – 1321
TL (mm) to W. Wt (kg)	W. Wt = 1 x 10^{-08} * ($TL^{\wedge 3.03}$)	4922	0.97	TL (mm): 245 – 1360 W. Wt (kg): 0.23 – 32.74
FL (mm) to W. Wt (kg)	W. Wt = 1 x 10^{-08} * ($FL^{\wedge 3.02}$)	3809	0.97	FL (mm): 217 – 1321 W. Wt (kg): 0.13 – 32.74
TL (mm) to G. Wt (kg)	G. Wt = 1 x 10^{-08} * ($TL^{\wedge 2.99}$)	527	0.96	TL (mm): 446 – 1295 G. Wt (kg): 0.99 – 27.02
FL (mm) to G. Wt (kg)	G. Wt = 9 x 10^{-9} * ($FL^{\wedge 3.05}$)	2407	0.98	FL (mm): 432 – 1335 G. Wt (kg): 0.99 – 32.21
SL (cm) to TL (cm) *for age-0 gag only*	TL = 1.85 * SL – 0.23	165	0.99	SL (cm): 2.5-10.0 TL (cm): 3.1-12.1

Table 2.3. Length-length and weight-weight regressions (no-intercept) for gag from the South Atlantic.

Sources	Ind. Var.	Dep. Var.	N	Parameter	S.E.	Adj. R^2	Pr > F
Length-Length Regressions:							
FL FWCC (n=176), SC DNR (MARMAP; n=3301), Headboat (n=215)	TL (mm)	FL (mm)	3692	1.0341	0.00020	0.9999	<0.0001
FL FWCC (n=145) & SC DNR (MARMAP; n=3582)	TL (mm)	SL (mm)	3727	1.1908	0.00044	0.9999	<0.0001
Whole Weight (WW)-Gutted Weight (GW):							
SC DNR (MARMAP)	WW (kg)	GW (kg)	136	1.0585	0.0014	0.9998	<0.0001

Note: WW = whole weight; GW = gutted weight
TL = total length; FL = fork length; SL = standard length

Table 2.4. Linearized weight-length regressions for gag from the South Atlantic.

Source	Ind. Var.	Dep. Var.	N	Intercept	S.E. Int	Slope	S.E. Slope	MSE	Adj. R^2	Pr > F
SC DNR (MARMAP; n=4020), Headboat (n=11915), TIP (n=539)	ln(WW)	ln(TL)	16474	-17.843	0.040	2.943	0.006	0.047	0.933	<0.0001
SC DNR (MARMAP; n=2348), MRFSS (n=1334)	ln(WW)	ln(FL)	3682	-15.688	0.113	2.633	0.017	0.100	0.863	<0.0001
SC DNR (MARMAP)	ln(WW)	ln(SL)	2248	-17.332	0.066	2.949	0.010	0.020	0.9735	<0.0001

Note: WW = whole weight; TL = total length; FL = fork length; SL = standard length

3 Commercial Fishery

Participants: Alan Bianchi, Steve Brown, Guy Davenport, Jack Holland, Nan Jenkins, Fritz Rohde, Steve Turner, Doug Vaughan (chair)

Others: Ching-Ping Chih, Kevin McCarthy, Bob Wiggers

3.1 Overview

A series of issues were discussed by the Commercial Working Group concerning stock boundaries between Gulf of Mexico and U.S. South Atlantic, the misidentification of gag as black grouper, and adjusting gag landings to include a portion of unclassified grouper species (primarily historical unclassified grouper landings prior to the mid-1980s). To adjust gag grouper for unclassified groupers, landings of all classified groupers are necessary (see grouper species codes in Table 3.1).

The Data Workshop decided to tabulate landings for 1963-2004. The previous stock assessment of Gulf of Mexico gag used landings starting in 1986 (Turner *et al.* 2001). The stock assessment method was a VPA which relies on having extensive information on age and size composition; 1986 was selected as the earliest year because grouper landings were first identified by species starting in 1986 and because size sampling was initiated only in 1984. The Data Workshop decided to tabulate possible gag landings starting in 1963, because of the possibility that alternative assessment methods which do not require age composition in every year might be investigated. The commercial landings data retained in data bases at the Southeast Fisheries Science Center start in 1962, however the group decided to tabulate U.S. Gulf landings only from 1963, because very little information exists on the areas where fish were caught in 1962 and in subsequent years substantial landings were taken from foreign waters.

Reported commercial landings of gag and other groupers are presented as are calculated (after adjustments for species misidentification and unclassified groupers) commercial gag landings are then presented as a series of tables and figures for the U.S. Gulf of Mexico gag grouper stock. Estimated discards are presented for recent years (2001-2004) subsequent to the last change in minimum size limit for the U.S. Gulf of Mexico. Additionally information is presented on sampling intensity and annual length frequency distributions by gear.

3.2 Commercial Landings

All landings are reported in gutted weight. Landings recorded in whole units in the ALS data base (Texas, Louisiana, Mississippi, and Alabama in all years, Florida 1986 and later) were converted to gutted weight using the standard ALS conversion factor of 1.18.

Statistical Area and Gear

The allocation of landings to one stock or the other was based on statistical areas (water bodies) recorded in the landings data or assigned to the landings from log book data. The specific definitions are provided in the Appendix 1. Capture gears of the landings were aggregated into five types: handline, longline, dive, trap, trawl and other. The gear codes in the landings data and the log book data assigned to each type also are defined in Appendix 1.

Statistical area and gear were recorded by dealers for most states in most years. They were not recorded in the monthly data for Florida in 1977-1996, nor Louisiana from 1990 through 1999 and for Texas gear was not recorded after 1992.. Gear and area were recorded in annual data for Florida, and they were recorded in relatively sparse logbook data starting in 1990 and more extensive logbook data in 1993 and later. The group consensus was data on gear and fishing area reported directly by fishermen through the logbook program was probably more accurate than the data reported by dealers and associated staff to the landings program (Accumulated Landings System, ALS).

The group decided to use the annual data for Florida to assign gear to the monthly data for 1977-1992. They also decided to use the logbook data to assign gear and area rather than the landings data where there were sufficient numbers of observations. There were relatively fewer observations in 1990-1992 for most states and larger numbers of observations for 1993 and later. Despite the relatively lower numbers of observations the log book data were used for Louisiana starting in 1990 because there was no other information available. For the other states the logs were used to assign gear and area for1993 and later.

Misidentification of Gag

Schirripa and Goodyear (1994) reported that historically gag often had been misidentified in the landings as black grouper, They used proportions [gag / (gag + black grouper)] of recreational landings by county in Florida to convert commercial landings of gag and black to gag; for Texas through Alabama it was assumed that all gag and black landings were gag. Turner *et al.* (2001) followed Schirripa and Goodyear's approach. SEDAR10-DW-24 (Chih and Turner, 2006) reviewed the proportions of gag in landings data as well as in biological sampling data collected by port agents at the dock in Gulf of Mexico ports.

The working group discussed at length the misidentification of gag. It was reported that port agents from Texas through Alabama confirmed that while black grouper did occasionally occur in the landings, gag accounted for nearly all of the landings of those two species. The group recommended that proportions of gag [gag/(gag+black)] by statistical area (Figure 1) from SEDAR10-DW-24 be used to calculate the total gag landings. The proportions from statistical areas 7-21 were similar (generally 0.97 and above) while many of the areas, especially off Texas to Mississippi, had low sample sizes; therefore the data for areas 7 and above were combined; the proportions used for analysis are shown in Table 1. Proportions in number were used rather than proportions in weight. There are differences in average weights of commercially landed gag and black grouper when the species are accurately identified. If most of the reported black grouper are gag, then using a proportion based on number of fish observed in the sampled landings would be more accurate that a proportion based on weight observed in the sampled landings.

Unclassified Groupers

Prior to 1986 nearly all groupers except two species, goliath and warsaw which were caught at very large sizes, were landed as 'grouper' in states bordering the Gulf of Mexico (Table 2). Starting in 1986 grouper landings began to be identified by species and the amount of unclassified groupers declined sharply. A proportion of the unclassified grouper landings were then converted to gag and black grouper.

Reported landings of gag and black grouper and all classified groupers combined are shown in Tables 3, 4 and 5. The annual proportions of gag and black grouper in classified groupers were used to calculate the annual amounts of unclassified groupers which were likely to have been each of those species. The proportions of gag and black from 1986-1989 combined were used to calculate the amount of unclassified groupers from 1963-1985 which might have been gag or black grouper. The annual proportions were calculated by year, state, county, gear and statistical area where possible; when there not observations for a stratum, more highly aggregated stratification was used. A similar approach was used for the multi-year proportions.

Calculated landings

The landings for gag and black grouper, both from reported landings and computed from unclassified groupers were combined. The proportion of gag and black which were likely gag (from SEDAR10-DW-24) were applied to those landings to compute 'calculated gag' (Table 6). For calculations involving reported gag and black grouper, if the calculated amount of gag landed was less than the amount of gag reported, then the amount of gag reported was used.

3.3 Commercial Discards

Size limits have been in place for the commercial fishery since February 1990 when a 20" limit was established and that limit was increased to 24" in June 2000. Size limits are thought to have resulted in discarding of undersized fish at sea.

Commercial discards were calculated from the number of handline trips made and the reported number of discards per trip as recorded in discard logs requested from a random sample of permitted fishermen (SEDAR10-DW-11). The final estimates of total discards (live and dead) by the handline fishery for 2001-2004 are given in Table 7. That document reported that about 10% of the discards were reported to be 'all dead', 'mostly dead' or 'kept not sold'; nearly all of the remainder were described as 'all alive' or 'majority alive' .

3.4 Biological Sampling

3.4.1 Sampling Intensity for Length and Age

The number of observations of lengths from the commercial landings by year and gear are shown in Table 8. In that table three gears are shown which are combined into ‘handline’; those are electric reel, rod and reel and handline.

Sampling fractions for size observations were calculated for the number of length observations for the commercial fisheries. The number of landed fish were obtained from the catch at age developed by Ortiz (SEADR10 AW document in preparation) from the landed catch at age in number of fish for Gulf of Mexico gag based on the calculated landings, size samples, age-length keys and the growth equation (Table 9). The overall length sampling fractions increased from 0.2-1% in the 1980’s, to 2-7% in the 1990’ and 3-5% from 2000-2004 (Table 10); length sampling fractions varied by gear with the longline fishery generally being more heavily sampled.

The number of age observations available (aged) for developing age-length keys for the commercial fishery are shown in Table 11; these were developed from the data summarized in SEDAR10-DW-02 (Lombardi *et al.* 2006). The overall age sampling fractions for the commercial fishery generally ranged from 0.1-0.3% for 1991-2000 and then were about 0.6-1% for 2001-2004. The increase in sampling fractions after 2000 occurred in both the handline and longline fisheries, though the increase started earlier in the longline fishery (1999) and was larger.

3.4.2 Length/Age Distribution

The length and age annual distribution of observed size samples by commercial fishery will be presented by Ortiz in a document for the assessment workshop on the development of the catch at age.

3.4.3 Adequacy for characterizing lengths

SEDAR10-DW-18 (Chih, 2006) showed that the length and age distributions of samples from trips on which small numbers of samples were taken differed from the distributions when larger numbers of samples were taken and that weighting the size samples from each trip by the amount of gag landings influenced the annual estimates of size composition. SEDEAR10-DW-18 recommended that age-length keys be used for calculating age composition rather than using the aggregated aged samples to represent the age composition. The group discussed these results extensively and recommended that age-length keys or similar approaches be used and that careful consideration be given to sample size in developing length or age composition estimates.

3.5 Research Recommendations

1. Increase sampling for otoliths for aging.
2. Improve at-sea observation for discards.

3.6 Literature Cited

Chih, C. 2006. Effect of some variations in sampling practices on the length frequency distribution of gag groupers caught by commercial fisheries in the Gulf of Mexico. SEDAR10-DW-18. 36p.

Chih, C. and S.C. Turner. 2006. Estimation of species misidentification in the commercial landing data of gag groupers and black groupers in the Gulf of Mexico. SEDAR10-DW-24. 36p.

Lombardi-Carlson, L.A., G.R. Fitzhugh, W.A. Fable, M. Ortiz, and C. Gardner. 2006. Age, length, and growth of Gag (*Mycteroperca microlepis*) from the northeastern Gulf of Mexico: 1979-2005. SEDAR10-DW-02. 57p.

Schirripa, M.J. and C.P. Goodyear. 1994. Status of the gag stocks of the Gulf of Mexico: assessment 1.0. NMFS, Southeast Fisheries Center, Miami Laboratory, Miami CRD-93/94-61. 156 pp.

Turner, S.C. C.E. Porch, D. Heinemann, G.P. Scott and M. Ortiz. 2001. Status of Gag in the Gulf of Mexico, Assessment 3.0. NMFS, Southeast Fisheries Center, Miami Laboratory, Miami SFD-2000/2001-118 pp.

Table 3.1. Proportions of gag in combined landings of gag and black grouper as estimated from TIP (Trip Interview Program) data. From SEDAR10-DW-24. Proportions are in number of fish.

statistical area	proportion
1	0.167
2	0.485
3	0.717
4	0.945
5	0.976
6	0.987
7	0.995
8	0.995
9	0.995
10	0.995
11	0.995
12	0.995
13	0.995
14	0.995
15	0.995
16	0.995
17	0.995
18	0.995
19	0.995
20	0.995
21	0.995

Table 3.2. Commercial landings of unclassified groupers caught in United States Gulf of Mexico waters in pounds gutted weight. Landings by spear, trap, and trawl were combined with other ensure confidentiality.

	handline	longline	other	total
1963	5,819,408		8,864	5,828,273
1964	6,926,771		30,412	6,957,183
1965	7,679,888		13,042	7,692,931
1966	6,878,768		17,659	6,896,427
1967	5,626,988		51,068	5,678,056
1968	6,097,085		40,268	6,137,353
1969	6,992,276		27,168	7,019,444
1970	6,826,371		33,692	6,860,063
1971	6,295,827		35,880	6,331,707
1972	6,578,807		43,849	6,622,656
1973	5,025,306		33,514	5,058,819
1974	5,635,386		17,084	5,652,469
1975	6,802,028		26,892	6,828,919
1976	5,822,592		39,281	5,861,873
1977	4,683,057		67,137	4,750,193
1978	4,276,249		129,435	4,405,684
1979	5,970,068	45,918	80,568	6,096,554
1980	5,967,652	701,039	92,354	6,761,045
1981	5,993,734	3,628,801	117,451	9,739,986
1982	5,410,300	6,546,482	137,803	12,094,585
1983	4,745,126	4,566,406	40,667	9,352,199
1984	4,996,900	3,824,822	341,682	9,163,404
1985	6,156,690	3,799,440	687,211	10,643,341
1986	226,619	325,331	15,122	567,072
1987	278,281	362,712	11,825	652,819
1988	403,766	298,432	10,502	712,700
1989	299,624	195,144	6,950	501,718
1990	131,892	111,922	9,008	252,821
1991	76,737	106,926	3,248	186,910
1992	95,123	88,428	2,439	185,990
1993	46,058	124,191	10,560	180,809
1994	18,764	45,211	4,299	68,274
1995	14,271	53,247	2,701	70,219
1996	9,570	38,479	427	48,476
1997	12,925	53,599	437	66,961
1998	25,620	75,932	759	102,311
1999	10,588	63,575	1,186	75,349
2000	11,149	35,949	884	47,982
2001	12,469	50,334	442	63,245
2002	8,841	37,650	347	46,837
2003	3,847	23,105	219	27,172
2004	6,766	28,434	602	35,802

Table 3.3. Reported commercial landings of gag from United States Gulf of Mexico waters in pounds gutted weight. Small amounts of landings in 1985 are not shown, and several gear categories (spear, trap, trawl and other) are combined to ensure confidentiality.

	handline	longline	other	total
1986	520,245	216,664	3,278	876,452
1987	416,616	245,672	1,114	827,451
1988	354,196	196,365	1,160	636,038
1989	493,443	218,418	5,359	936,128
1990	517,082	319,804	6,806	1,045,597
1991	644,798	280,308	26,132	1,224,350
1992	784,181	430,472	32,085	1,511,639
1993	994,836	408,382	81,175	1,723,701
1994	893,297	288,941	102,559	1,511,229
1995	903,982	345,144	90,563	1,601,448
1996	880,404	344,934	53,770	1,559,269
1997	969,063	389,066	70,142	1,656,524
1998	1,700,972	579,963	74,955	2,637,463
1999	1,350,454	520,431	62,550	2,151,062
2000	1,462,782	582,604	70,239	2,311,179
2001	1,884,858	951,165	93,627	3,121,477
2002	1,730,090	995,477	56,530	2,927,583
2003	1,308,524	1,039,490	59,566	2,563,867
2004	1,560,443	1,049,723	68,444	2,806,127

Table 3.4. Reported commercial landings of black grouper from United States Gulf of Mexico waters in pounds gutted weight. Small amounts of landings in 1985 are not shown, and several gear categories (spear, trap, trawl and other) are combined to ensure confidentiality.

	handline	longline	other	total
1986	677,365	346,969	42,697	1,067,032
1987	497,399	501,112	45,984	1,044,495
1988	439,843	252,638	34,954	727,436
1989	775,563	274,912	49,603	1,100,079
1990	670,127	389,763	55,070	1,114,959
1991	373,731	268,514	64,181	706,426
1992	263,896	212,377	70,424	546,697
1993	323,354	100,027	44,712	468,093
1994	293,303	83,706	30,067	407,077
1995	287,806	63,239	27,556	378,601
1996	259,518	75,684	23,933	359,135
1997	156,832	55,743	18,930	231,505
1998	177,240	52,542	9,714	239,495
1999	152,923	58,793	10,246	221,963
2000	154,725	66,399	16,184	237,308
2001	194,573	81,823	15,494	291,889
2002	194,132	79,444	12,250	285,826
2003	169,843	135,738	14,198	319,779
2004	189,035	116,281	9,149	314,464

Table 3.5. Reported commercial landings of classified grouper (except goliath and warsaw) from United States Gulf of Mexico waters in pounds gutted weight. Small amounts of landings in 1983 and 1984 are not shown, and several gear categories (spear, trap, trawl and other) are combined to ensure confidentiality.

	handline	longline	other	total
1985	76,618	111,652	-	188,269
1986	4,979,364	4,080,719	767,893	9,827,976
1987	4,013,412	5,188,442	499,287	9,701,142
1988	3,436,591	3,646,921	576,684	7,660,195
1989	5,405,735	4,039,329	644,050	10,089,113
1990	4,024,821	3,480,664	418,948	7,924,433
1991	3,463,845	4,011,621	506,871	7,982,338
1992	2,894,616	4,164,113	728,606	7,787,336
1993	2,895,733	5,616,077	951,446	9,463,256
1994	2,667,899	4,210,230	1,139,854	8,017,982
1995	2,614,166	3,787,627	1,208,853	7,610,647
1996	2,209,351	4,047,513	674,098	6,930,962
1997	2,304,080	4,541,342	825,001	7,670,422
1998	2,805,690	4,235,941	427,384	7,469,015
1999	3,005,234	5,534,881	910,907	9,451,022
2000	3,531,477	4,928,745	1,205,564	9,665,787
2001	3,908,904	5,520,356	953,301	10,382,561
2002	3,929,881	5,198,773	1,067,201	10,195,855
2003	2,896,008	5,606,359	818,574	9,320,941
2004	3,457,456	5,854,879	876,385	10,188,719

Table 3.6. Calculated commercial landings of gag from United States Gulf of Mexico waters by gear and year and by state and year. The other gear category is combined with spear, trap and trawl and longline in 1979) and the other state category includes Texas, Louisiana, Mississippi, Alabama and east Florida to ensure confidentiality.

	handline	longline	other	total
1963	1,288,786		1,446	1,290,231
1964	1,632,461		9,088	1,641,549
1965	1,815,589		573	1,816,162
1966	1,456,567		1,226	1,457,793
1967	1,155,546		9,840	1,165,387
1968	1,192,285		4,414	1,196,699
1969	1,376,519		3,206	1,379,725
1970	1,283,655		2,503	1,286,158
1971	1,376,503		2,782	1,379,285
1972	1,460,382		3,980	1,464,362
1973	1,081,223		4,899	1,086,122
1974	1,184,110		1,355	1,185,465
1975	1,446,622		4,464	1,451,086
1976	1,198,439		9,114	1,207,552
1977	977,267		7,513	984,780
1978	875,262		10,951	886,213
1979	1,342,246		11,068	1,353,314
1980	1,317,860	89,303	11,866	1,419,030
1981	1,498,745	467,068	15,609	1,981,421
1982	1,334,618	1,009,999	14,163	2,358,780
1983	1,039,424	681,064	17,651	1,738,139
1984	1,098,289	433,159	18,408	1,549,855
1985	1,398,342	380,850	27,878	1,807,070
1986	1,155,013	517,406	29,022	1,701,441
1987	852,580	656,042	29,544	1,538,166
1988	791,072	402,244	23,178	1,216,494
1989	1,235,438	426,017	31,375	1,692,830
1990	1,129,790	622,484	40,816	1,793,090
1991	992,523	509,707	63,090	1,565,320
1992	1,002,507	592,824	68,549	1,663,880
1993	1,280,295	479,061	105,760	1,865,116
1994	1,147,880	351,816	119,045	1,618,740
1995	1,157,053	389,941	104,670	1,651,664
1996	1,106,013	393,141	67,503	1,566,658
1997	1,100,767	414,245	82,634	1,597,645
1998	1,847,898	601,209	81,579	2,530,686
1999	1,480,936	548,525	68,277	2,097,739
2000	1,587,117	614,935	81,259	2,283,311
2001	2,040,199	987,396	100,915	3,128,510
2002	1,890,715	1,031,132	61,659	2,983,506
2003	1,445,601	1,113,426	67,095	2,626,122
2004	1,717,249	1,111,637	72,807	2,901,692

	wFL	other	total
1963	1,269,366	20,865	1,290,231
1964	1,623,431	18,118	1,641,549
1965	1,799,778	16,383	1,816,162
1966	1,441,628	16,165	1,457,793
1967	1,147,483	17,904	1,165,387
1968	1,163,785	32,914	1,196,699
1969	1,353,861	25,864	1,379,725
1970	1,248,608	37,550	1,286,158
1971	1,339,665	39,620	1,379,285
1972	1,422,108	42,254	1,464,362
1973	1,040,660	45,462	1,086,122
1974	1,157,593	27,872	1,185,465
1975	1,424,570	26,516	1,451,086
1976	1,180,614	26,939	1,207,552
1977	957,726	27,053	984,780
1978	866,721	19,492	886,213
1979	1,333,948	19,366	1,353,314
1980	1,409,281	9,749	1,419,030
1981	1,964,441	16,980	1,981,421
1982	2,346,331	12,449	2,358,780
1983	1,714,472	23,667	1,738,139
1984	1,495,345	54,510	1,549,855
1985	1,764,596	42,474	1,807,070
1986	1,649,660	51,781	1,701,441
1987	1,479,086	59,079	1,538,166
1988	1,163,544	52,950	1,216,494
1989	1,656,431	36,399	1,692,830
1990	1,759,936	33,154	1,793,090
1991	1,526,374	38,946	1,565,320
1992	1,645,162	18,718	1,663,880
1993	1,842,124	22,993	1,865,116
1994	1,601,099	17,641	1,618,740
1995	1,625,558	26,106	1,651,664
1996	1,541,885	24,773	1,566,658
1997	1,563,166	34,479	1,597,645
1998	2,467,556	63,130	2,530,686
1999	2,033,217	64,521	2,097,739
2000	2,224,179	59,133	2,283,311
2001	3,088,082	40,427	3,128,510
2002	2,939,407	44,098	2,983,506
2003	2,588,772	37,350	2,626,122
2004	2,850,392	51,300	2,901,692

Table 3.7. Estimated number of gag discarded by handline vessels fishing in the Gulf of Mexico. From SEDAR10-DW-11.

	handline trips	total discards
2001	9,876	72,148
2002	9,921	75,084
2003	9,789	106,485
2004	9,159	52,525

Table 3.8. Number of lengths observations of gag caught in the Gulf of Mexico commercial fisheries.

	Handline							
	Electric Reel	Rod & Reel	Handline	Sub Total	Longline	Trap	Other	Total
1984	617	212	-	829	458	-	1	1,288
1985	705	68	2	775	597	-	91	1,463
1986	276	78	4	358	1,133	25	24	1,540
1987	497	51	11	559	685	-	-	1,244
1988	163	12	-	175	276	-	-	451
1989	35	-	7	42	170	21	-	233
1990	679	157	148	984	1,665	1	-	2,650
1991	341	482	182	1,005	940	17	19	1,981
1992	749	321	80	1,150	929	11	49	2,139
1993	633	1,227	28	1,888	789	11	53	2,741
1994	793	2,026	1	2,820	777	23	61	3,681
1995	1,791	643	3	2,437	997	-	26	3,460
1996	2,061	1,084	2	3,147	1,038	23	16	4,224
1997	947	2,156	261	3,364	1,224	38	394	5,020
1998	3,345	2,775	1,879	7,999	5,067	128	94	13,288
1999	3,042	2,569	266	5,877	4,654	181	323	11,035
2000	2,137	1,622	158	3,917	4,168	182	145	8,412
2001	2,734	2,567	132	5,433	4,151	285	11	9,880
2002	1,911	2,157	48	4,116	4,137	285	15	8,553
2003	1,267	914	20	2,201	3,921	85	40	6,247
2004	2,017	818	31	2,866	2,664	-	62	5,592

Table 3.9. Length sampling fractions for Gulf of Mexico commercial fisheries for gag.

	handline	longline	other	total
1984	1.2%	1.5%	0.0%	1.3%
1985	0.9%	2.1%	2.4%	1.2%
1986	0.4%	3.4%	0.7%	1.3%
1987	1.0%	1.8%	0.0%	1.3%
1988	0.4%	1.2%	0.0%	0.6%
1989	0.1%	0.7%	0.0%	0.2%
1990	1.6%	5.5%	0.0%	2.7%
1991	1.6%	3.7%	0.2%	2.0%
1992	1.8%	3.3%	0.6%	2.1%
1993	2.0%	3.3%	0.4%	2.1%
1994	3.0%	3.7%	0.5%	2.9%
1995	2.6%	4.4%	0.2%	2.7%
1996	2.7%	4.4%	0.2%	2.9%
1997	2.7%	5.0%	3.6%	3.2%
1998	4.3%	14.5%	1.0%	5.8%
1999	4.4%	15.7%	3.8%	6.5%
2000	2.8%	13.6%	1.4%	4.6%
2001	3.2%	7.9%	0.1%	4.2%
2002	2.8%	7.6%	0.2%	4.1%
2003	2.0%	6.6%	0.5%	3.5%
2004	2.1%	4.4%	0.6%	2.7%

Table 3.10. Number of gag landed by the Gulf of Mexico commercial fisheries estimated by Ortiz (to be documented in an assessment workshop report).

	Handline	Longline	Others	total
1984	68,710	30,242	2,533	101,485
1985	89,258	28,105	3,733	121,096
1986	80,012	33,700	3,316	117,028
1987	54,293	37,208	3,958	95,459
1988	46,138	22,829	2,981	71,948
1989	67,377	23,532	4,202	95,111
1990	60,773	30,428	5,377	96,578
1991	63,723	25,698	7,647	97,068
1992	65,545	28,360	8,381	102,286
1993	94,266	23,905	12,438	130,609
1994	93,161	21,191	13,525	127,877
1995	92,746	22,544	12,056	127,346
1996	115,163	23,790	8,785	147,738
1997	123,176	24,716	10,828	158,720
1998	185,848	34,943	9,793	230,584
1999	132,454	29,601	8,531	170,586
2000	140,144	30,722	10,154	181,020
2001	169,742	52,447	12,148	234,337
2002	145,258	54,646	7,989	207,893
2003	109,796	59,659	8,791	178,246
2004	137,009	60,589	9,581	207,179

Table 3.11. Age sampling fractions for Gulf of Mexico commercial fisheries for gag.

	Handline	Longline	Other	Total
1991	0.3%	0.0%	0.0%	0.2%
1992	0.1%	0.1%	0.0%	0.1%
1993	0.4%	0.1%	0.0%	0.3%
1994	0.5%	0.0%	0.0%	0.3%
1995	0.3%	0.1%	0.0%	0.2%
1996	0.2%	0.2%	0.0%	0.2%
1997	0.0%	0.0%	0.0%	0.0%
1998	0.1%	0.3%	0.0%	0.1%
1999	0.1%	0.8%	0.0%	0.2%
2000	0.3%	0.6%	0.1%	0.3%
2001	0.4%	1.7%	0.0%	0.7%
2002	0.6%	2.0%	0.2%	0.9%
2003	0.5%	1.9%	0.0%	0.9%
2004	0.7%	2.4%	0.0%	1.1%

Figure 3.1. Most statistical areas for the Gulf of Mexico region.

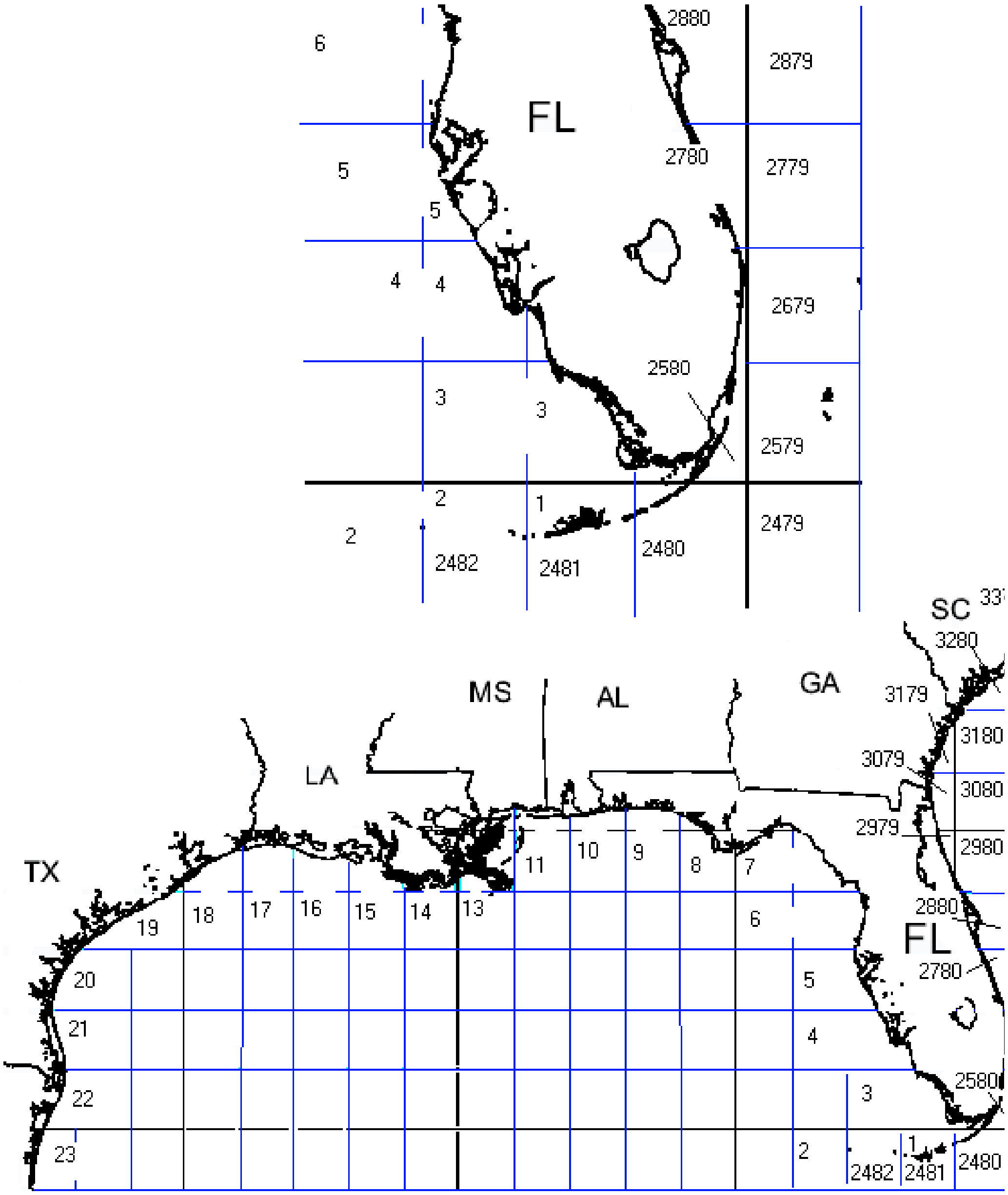
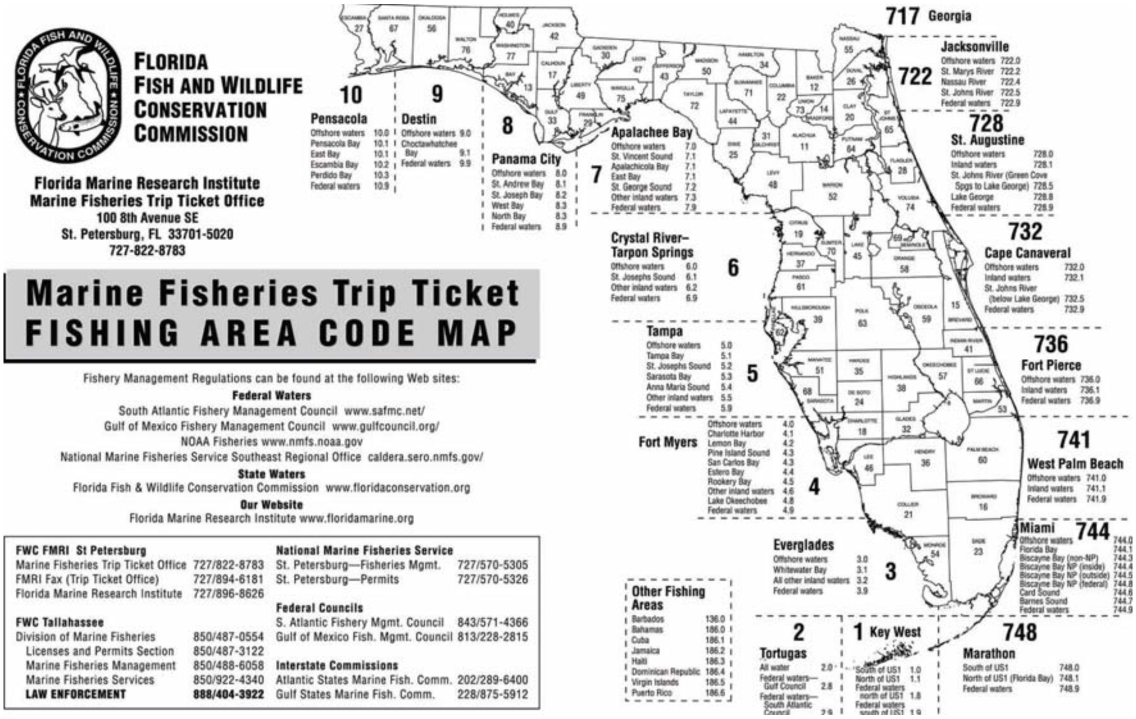


Figure 3.2. Statistical areas for Florida.



Appendix 1. Statistical area and gear code assignments.

Appendix 1. Table 1. Water body codes from the Florida Keys area used to assign grouper landings to the south Atlantic region or the Gulf of Mexico region.

water body	Atlantic	Gulf
0010	x	
0011		x
0018		x
0019	x	
0020		x
0028		x
0029		x
5000		x
7140-7440	x	
7441		x
7442-7480	x	
7481		x
7489	x	
7994-7997	x	

Appendix 1. Table 2. Gear codes from landings data and log book data assigned to gears used for tabulating landings for the assessment.

landings data (ALS)

gear code	gear
200-299	trawls
345,355	trap
600-660,690	handline
675-677	longline
760, 943	dive
	other

log book data

gear code	gear
E,H	handline
L	longline
P,S	dive
T	trap
	other

Appendix 2. **Addendum to Commercial Landings (Section 3.2):**

NMFS SEFIN Accumulated Landings(ALS)

Information on the quantity and value of seafood products caught by fishermen in the U.S. has been collected as early as the late1890s. Fairly serious collection activity began in the 1920s. The data set maintained by the Southeast Fisheries Science Center (SEFSC) in the SEFIN database management system is a continuous data set that begins in 1962.

In addition to the quantity and value, information on the gear used to catch the fish, the area where the fishing occurred and the distance from shore are also recorded. Because the quantity and value data are collected from seafood dealers, the information on gear and fishing location are estimated and added to the data by data collection specialists. In some states, this ancillary data is not available.

Commercial landings statistics have been collected and processed by various organizations during the 1962-to-present period that the SEFIN data set covers. During the 16 years from 1962 through 1978, these data were collected by port agents employed by the Federal government and stationed at major fishing ports in the southeast. The program was run from the Headquarters Office of the Bureau of Commercial Fisheries in Washington DC. Data collection procedures were established by Headquarters and the data were submitted to Washington for processing and computer storage. In 1978, the responsibility for collection and processing were transferred to the SEFSC.

In the early 1980s, the NMFS and the state fishery agencies within the Southeast began to develop a cooperative program for the collection and processing of commercial fisheries statistics. With the exception of two counties, one in Mississippi and one in Alabama, all of the general canvass statistics are collected by the fishery agency in the respective state and provided to the SEFSC under a comprehensive Cooperative Statistics Program (CSP).

The purpose of this documentation is to describe the current collection and processing procedures that are employed for the commercial fisheries statistics maintained in the SEFIN database.

1960 - Late 1980s
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Although the data processing and database management responsibility were transferred from the Headquarters in Washington DC to the SEFSC during this period, the data collection procedures remained essentially the same. Trained data collection personnel, referred to as fishery reporting specialists or port agents, were stationed at major fishing ports throughout the Southeast Region. The data collection procedures for commercial landings included two parts.

The primary task for the port agents was to visit all seafood dealers or fish houses within their assigned areas at least once a month to record the pounds and value for each species or product type that were purchased or handled by the dealer or fish house. The agents summed the landings and value data and submitted these data in monthly reports to their area supervisors. All of the monthly data were submitted in essentially the same form.

The second task was to estimate the quantity of fish that were caught by specific types of gear and the location of the fishing activity. Port agents provided this gear/area information for all of the landings data that they collected. The objective was to have gear and area information assigned to all monthly commercial landings data.

There are two problems with the commercial fishery statistics that were collected from seafood dealers. First, dealers do not always record the specific species that are caught and second, fish or shellfish are not always purchased at the same location where they are unloaded, i.e., landed.

Dealers have always recorded fishery products in ways that meet their needs, which sometimes make it ambiguous for scientific uses. Although the port agents can readily identify individual species, they usually were not at the fish house when fish were being unloaded and thus, could not observe and identify the fish.

The second problem is to identify where the fish were landed from the information recorded by the dealers on their sales receipts. The NMFS standard for fisheries statistics is to associate commercial statistics with the location where the product was first unloaded, i.e., landed, at a shore-based facility. Because some products are unloaded at a dock or fish house and purchased and transported to another dealer, the actual 'landing' location may not be apparent from the dealers' sales receipts. Historically, communications between individual port agents and the area supervisors were the primary source of information that was available to identify the actual unloading location.

Cooperative Statistics Program
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In the early 1980s, it became apparent that the collection of commercial fisheries statistics was an activity that was conducted by both the Federal government and individual state fishery agencies. Plans and negotiations were initiated to develop a program that would reduce duplication of effort and continue to provide the fisheries statistics that are needed for management by both Federal and state agencies. By the mid-1980s, formal cooperative agreements had been signed between the NMFS/SEFSC and each of the eight coastal states in the southeast, Puerto Rico and the US Virgin Islands.

Initially, the data collection procedures that were used by the states under the cooperative agreements were essentially the same as the historical NMFS procedures. As the states developed their data collection programs, many of them promulgated legislation that authorized their fishery agencies to collect fishery statistics. Many of the state statutes include mandatory data submission by seafood dealers.

Because the data collection procedures (regulations) are different for each state, the type and detail of data varies throughout the Region. The commercial landings database maintained in SEFIN contains a standard set of data that is consistent for all states in the Region.

A description of the data collection procedures and associated data submission requirements for each state follows.

Florida
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Prior to 1986, commercial landings statistics were collected by a combination of monthly mail submissions and port agent visits. These procedures provided quantity and value, but did not provide information on gear, area or distance from shore. Because of the large number of dealers, port agents were not able to provide the gear, area and distance information for monthly data. This information, however, is provided for annual summaries of the quantity and value and known as the Florida Annual Canvas data.

Beginning in 1986, mandatory reporting by all seafood dealers was implemented by the State of Florida. The State requires that a report (ticket) be completed and submitted to the State for every trip. Dealers have to report the type of gear as well as the quantity (pounds) purchased for each species. Information on the area of catch can also be provided on the tickets for individual trips. As of 1986 the ALS system relies solely on the Florida trip ticket data to create the ALS landings data for all species other than shrimp.

Alabama
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Data collection in Alabama is voluntary and is conducted by state and federal port agents that visit dealers and docks monthly. Summaries of the total landings (pounds) and value for species or market category are recorded. Port agents provide information on gear and fishing area from their knowledge of the fisheries and interaction with fishermen and dealers. As of mid- 2000 the State of Alabama required fishermen and dealers to report all commercial landings data through a trip ticket system. As of 2001 the ALS system relies solely on the Alabama trip ticket data to create the ALS landings data for Alabama.

Mississippi
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Data collection in Mississippi is voluntary and is conducted by state and federal port agents that visit dealers and docks monthly. Summaries of the total landings (pounds) and value for species or market category are recorded. Port agents provide information on gear and fishing area from their knowledge of the fisheries and interaction with fishermen and dealers.

Louisiana

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Prior to 1993, commercial landings statistics were collected in Louisiana by Federal port agents following the traditional procedures established by the NMFS. Monthly summaries of the quantity and value were collected from each dealer in the state. The information on gear, area and distance from shore were added by the individual port agents.

Beginning in January 1993, the Department of Wildlife and Fisheries, State of Louisiana began to enforce the states' mandatory reporting requirement. Dealers have to be licensed by the State and are required to submit monthly summaries of the purchases that were made for individual species or market categories. With the implementation of the State statute, Federal port agents did not participate in the collection of commercial fishery statistics.

Since the implementation of the State program, information on the gear used, the area of catch and the distance from shore has not been added to the landings statistics (1992-1999). In 1998 the State of Louisiana required fishermen and dealers to report all commercial landings data through a trip ticket system. This data contains detailed landings information by trip including gear, area of capture and vessel information. As of 2000 the ALS system relies solely on the Louisiana trip ticket data to create the ALS landings data for Louisiana.

Texas

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The State has mandatory reporting requirement for dealers licensed by the State. Dealers are required to submit monthly summaries of the quantities (pounds) and value of the purchases that were made for individual species or market categories.

Information on gear, area and distance from shore are added to the state data by SEFSC personnel. Furthermore, landings of species that are unloaded in Texas, but transported to locations in other states are added to the commercial landings statistics by SEFSC personnel.

NMFS SEFIN Annual Canvas Data for Florida

The Florida Annual Data files from 1976 – 1996 represent annual landings by county(from dealer reports) which are broken out on a percentage estimate by species, gear, area of capture, and distance from shore. These estimates are submitted by Port agents, which were assigned responsibility for the particular county, from interviews and discussions from dealers and fishermen collected through out the year. The estimates are processed against the annual landings totals by county on a percentage basis to create the estimated proportions of catch by the gear, area and distance from shore.(The sum of percentages for a given Year, State, County, Species combination will equal 100.

Area of capture considerations:
ALS is considered a commercial landings data base which reports where the marine resource was landed. With the advent of some State trip ticket programs as the data source the definition is more loosely applied (Louisiana Trip tickets for example report landings from the dealer location not necessarily from where it was landed). As such one cannot assume reports from the ALS by State or county will accurately inform you of Gulf vs. South Atlantic vs. Foreign catch. In order to make that determination you must consider the area of capture.

Florida Annual Canvass 1976-1996 considerations:

1. 1976-1985 Data is as landed weight which was normally landed in a gutted condition. In order to convert to whole weight a factor of 1.18 is universally applied for groupers.
2. State 00 and Grid 0000 in the data set are marine product landed else where and trucked into the State of Florida and are considered to be duplicated else where because they are theoretically reported back to the State of landing and are not included in the Florida totals.
3. State 12 is in the data set represents Florida interior counties which were landed on Florida East Coast and not included in the Gulf catches.

4. Gulf of Mexico Gag Grouper Recreational Statistics Group

21 April 2006

Convened 23-27 January 2006, Charleston, SC

OVERVIEW

Gag grouper (*Mycteroperca microlepis*) represent an important recreational fishery resource in the Gulf of Mexico. Recent recreational landings of gag have topped 500,000 fish annually, with millions more caught and discarded. This report represents the best scientific judgment of the SEDAR 10 Data Workshop, with ideas first vetted in the Recreational Statistics Group but final decisions left to the full working group. A summary of findings are presented here along with discussion of controversies that arose during the workshop.

LANDINGS

General Issues

Monroe County

For management purposes and due to the possibility of distinct stock structure, the Gulf of Mexico and South Atlantic Fishery Management Council (GMFMC and SAFMC) gag grouper stocks were split at the Florida Keys, with a line running down the center of the Keys and then west from Key West to the Dry Tortugas. Unfortunately, this split does not correspond exactly with reporting areas for recreational catches. The Marine Recreational Fisheries Statistics Survey (MRFSS) include all of Monroe County landings in their official estimates for West Florida, yet catches in Monroe County come from both sides of the Keys. Similarly, Headboat Survey reporting areas 12 and 17, which are landings by Atlantic and Keys-based vessels fishing off the Keys and Dry Tortugas, include trips to both sides of the delineation line.

Regarding the MRFSS data, three options were considered. The first was to keep Monroe County catches in the Gulf, which is the default convention for MRFSS data. This alternative was rejected because of the sense that a reef-oriented fish like gag grouper was more likely to come from reef habitats to the south of the Keys (e.g., SAFMC) rather than grass habitats to the north (e.g., GMFMC). We also considered examining intercept data, which would include a landing location, as a way of dividing Monroe County catches. This alternative was also rejected because landing locations do not necessarily indicate on which side of the Keys the fishing activity took place. Instead, it was concluded that the best alternative was to assign Monroe County MRFSS catches to the SAFMC gag grouper stock. This assignment matches the general sense that grouper catches come from the south side of the Keys, and avoids extensive analyses on what is an extremely small fraction of overall catches. This method is also consistent with data treatments in previous assessments (e.g., SEDAR 9-DW-Reports).

Regarding headboat data, two alternatives were considered. The first was to examine effort records reported by captains in logbooks (usually not all trips), which often contain location reported to either 10 minute grids or latitude and longitude rounded to whole numbers. Prior to 1986, the location information was provided for 98% of all trips reported in logbooks. However, from 1986 on, location was only identified 77% of the time (Matter, SEDAR10-DW-27). It is believed that the drop in cooperation was a result of increased concern about the possibility this information would be used in designating marine protected areas. As a result, the location reports may not be random or representative. Also, since location information has not been used to the degree that other aspects of the headboat dataset have, it has not been as carefully error-checked and cleaned. Moreover, there was concern among some members of the group that location reports may have been inaccurate out of concern that favorite fishing spots might be closed. These concerns were supported by the fact that some locations were reported on land or well outside the management area. However, in support of their general accuracy, the distribution of trips that caught gag generally matched the sense of fishing locations (Fig. 1). Therefore, we examined them with the possibility of using their distribution to partition catches.

In area 12, there were a number of trips reported in areas that would unambiguously be considered the SAFMC management area but few that would unambiguously be considered the GMFMC management area (Fig, 1a). A large proportion of trips were reported in grid squares that contained waters on both side of the dividing line. In area 17, the same pattern held but with an even larger proportion of trips reported in grids that fell on the dividing line (Fig. 1b). All things considered, we concluded that the evidence did not warrant diverging from the *status quo* technique of assigning area 12 and 17 to the SAFMC gag grouper stock.

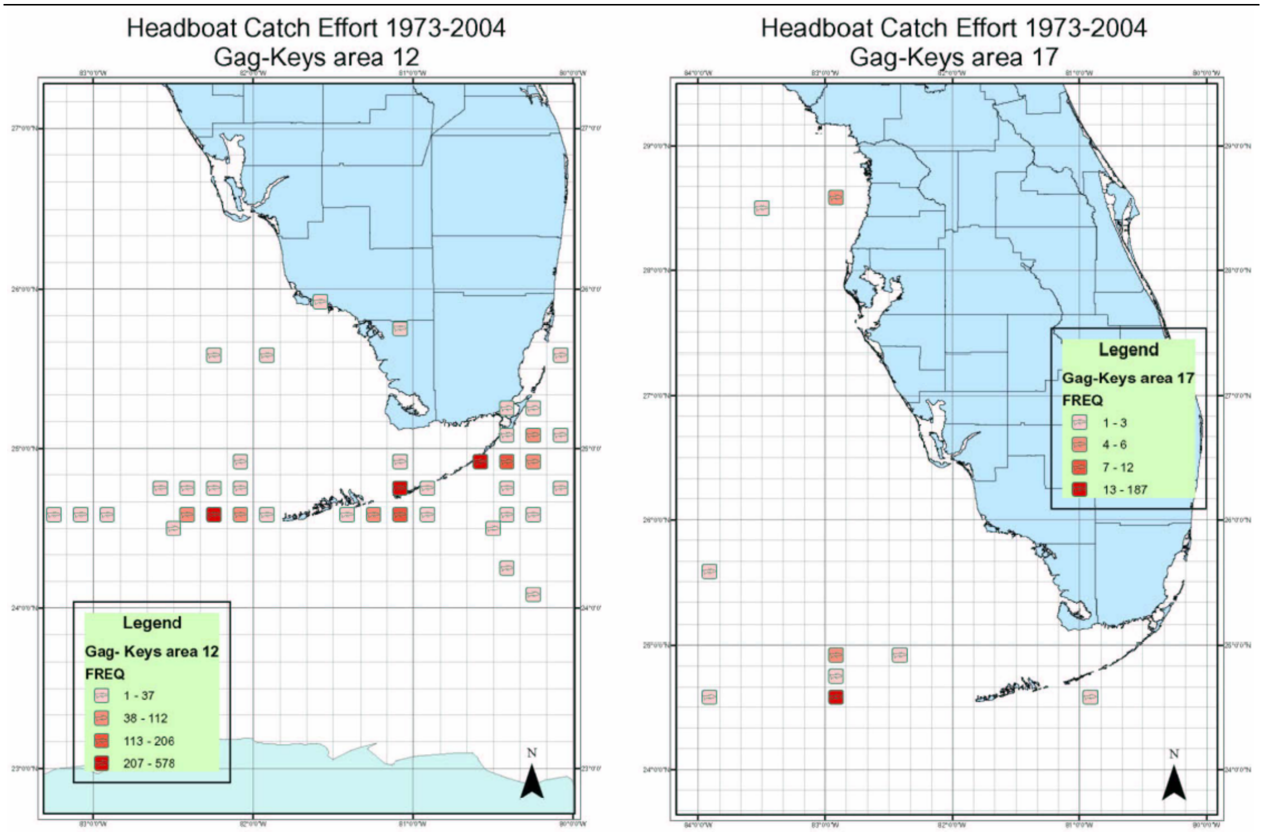


Fig. 1—Geographic distribution of headboat trips in Headboat Survey areas 12 and 17 on which gag grouper were caught, as reported in vessel logbooks (from Matter, SEDAR10-DW-27).

Misreporting of gag as black grouper

Gag grouper (*Mycteroperca microlepis*) and black grouper (*Mycteroperca bonaci*) look similar. This only adds to confusion caused by the fact that, in parts of the Gulf, *Mycteroperca microlepis* has traditionally been called black grouper. The MRFSS data suggest that these challenges resulted in misreporting of many gag landings as black groupers prior to 1990 (Table 1, and Phares et al., SEDAR10-DW-26). The problem was apparently corrected with updated interviewer training, interview supervision, and contractor QA/QC work with many new requirements that were implemented in the 1990 MRFSS contracts. Prior to that year, the numbers of black and gag grouper reported in MRFSS landings were fairly equal, whereas since that time gag landings have swamped black grouper landings in all counties (Table 1) except Monroe County, which has been assigned to the SAFMC stock.

Table 1—Observed gag versus black grouper in MRFSS. Observed gag landings (type A) as a percentage of observed gag + observed black grouper for the Gulf of Mexico MRFSS survey, by year and county.

Area/ Year	LA	MS	AL	FLW Excl Mon	Esc-Wak	Tay	Dix	Lev	Cit	Hern	Pas	Pin	Hil	Man	Sar	Cha	Lee	Col
1981			75	36	35				0			80		24	50		6	0
1982	0	0		53	9	15		0	90		100	85		100	100		10	
1983	0		0	60	42		0		100		86	71		45	100	0	100	
1984	50			61	0				40		33	72		33	9			44
1985	100		0	90	0						7	98		100	0		0	0
1986	38	100	49	55	2						100	82		0	0	0	0	0
1987	20	100	67	53	35	0					88	84		69	100			0
1988	0	74	100	46	29	0					75	75		67	40	100	38	
1989	100	89	100	81	94							74		100	100	27	100	100
1990			100	96	97		100		100		100	97			100	0		
1991	100	100	100	99	100	100		100	100		100	100	100	100	75	100	100	
1992	100	100	100	99	100		100	100	100	100	100	100	100	100	100	100	43	100
1993	100	100	100	100	100		100		100	100	100	100	100	100	100	100		
1994	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	86	100	100
1995	100	100	100	99	100	81		100	100	100	100	99	100	100	100	100	100	
1996	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		100	100
1997	100	100	100	98	99	100	100	100	100	100	100	100	100	100	74	67	100	100
1998	83	100	100	100	99	67	100	100	100	100	100	100	100	100	99	100	100	100
1999	100	100	100	100	100	100	100	97	100	100	100	99	100	98	98	100	100	100
2000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2001	88	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2002	90	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2003	100	100	100	100	100	100	100	100	100	100	100	100	100	100	96	100	100	100
2004	100		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	96
Mean 90-04	**97.2**	**100**	**100**	**99.4**	99.7	95.7	100	99.8	100	100	100	99.7	100	99.9	96.1	89.5	95.6	99.6

Given this evidence, we chose to correct for the likely misreporting of gag as black grouper prior to 1990. To do so, we examined the data from 1990 onwards and calculated gag as a proportion of all gag and black grouper. This proportion averaged 0.972 for Louisiana, 1 for Mississippi and Alabama, and 0.994 for West Florida, excluding Monroe County. Then, gag catches prior to

1990 were adjusted by applying this proportion to the sum of gag and black grouper for those years.

Headboat data were also examined (Table 2). Outside of the Florida Keys and Dry Tortugas (areas 12, 17, and 18), catches were predominantly gag. Moreover, there seemed to be some consistency in the proportion gag over the time series. The only apparent anomalies were from area 23 in 1986 and 1987. However, absent an external rationale for potential misreporting, the group decided to move forward with these numbers as is.

Table 2—Gag versus black grouper in Headboat Survey. Gag landings as a percentage of observed gag + observed black grouper for the Gulf of Mexico Headboat Survey, by year and area. From Phares et al., SEDAR10-DW-26.

	TX West	TX Mid	TX East	LA	AL/ FLW Panh	FLW Mid gr	FLW SW	FLW Tortu	FLW Tortu	FLW Keys	Total Gulf
Area:	27	26	25	24	23	22	21	18	17	12	Pct
1986	94	100	90	87	62	100	86	98	5	31	80
1987	82	73	98	95	62	100	93		9	28	81
1988	87	76	97	100	99	100	96		8	37	92
1989	89	90	91	96	91	79	94	53	1	40	90
1990	100	75	96	100	91	100	92	67	18	55	92
1991	92	98	93	67	93	90	90	48	0	29	88
1992	100	89	78	68	98	100	87	56	14	24	86
1993	100	100	95	98	96	100	93	73	27	30	91
1994	100	97	93	99	99	94	93	100	21	23	90
1995	100	98	97	97	100	100	69		13	32	73
1996	100	53	99	100	98		83		17	32	86
1997	100	69	98	97	100	95	73		14	40	82
1998	100	99	99	100	99	100	85		31	49	91
1999	100	96	99	51	97	89	99		44	18	95
2000	89	83	96	36	99	97	99		44	32	97
2001	90	90	66	63	98	62	96		15	21	83
2002	99	71	92		99	87	98		10	24	93
2003	99	86	86	100	99	89	98		19	40	95
2004	97	72	56		99	87	99		8	75	95

MRFSS

Shore mode

There was an extensive discussion about catches from MRFSS shore mode. This mode is poorly sampled, with sampling fractions ranging from 0.002 to 0.2%. Therefore large expansion factors are used, which can make rare events appear highly variable. Conventionally, shore mode is excluded entirely or the data are used, presuming that the variability will be swamped by other modes with larger landings or accounted for by considering CVs in the model. Shore mode cannot be entirely ignored for GMFMC gag and the use of CVs is complicated by the fact that this mode is unlikely to be treated as a separate fleet in the model (which would require the estimation of a number of distinct selectivity parameters and F multipliers). One hypothesis was that shore catches might truly be highly variable and indicate recruitment of relatively young fish. This hypothesis was explored by comparing spikes in shore mode catches to periods that would correspond with the appearance of known strong year classes (Fig. 2). This comparison indicated that shore mode catches might show a weak signal for some recruitment events, but also that the noise in shore mode may partially or fully swamp recruitment signals.

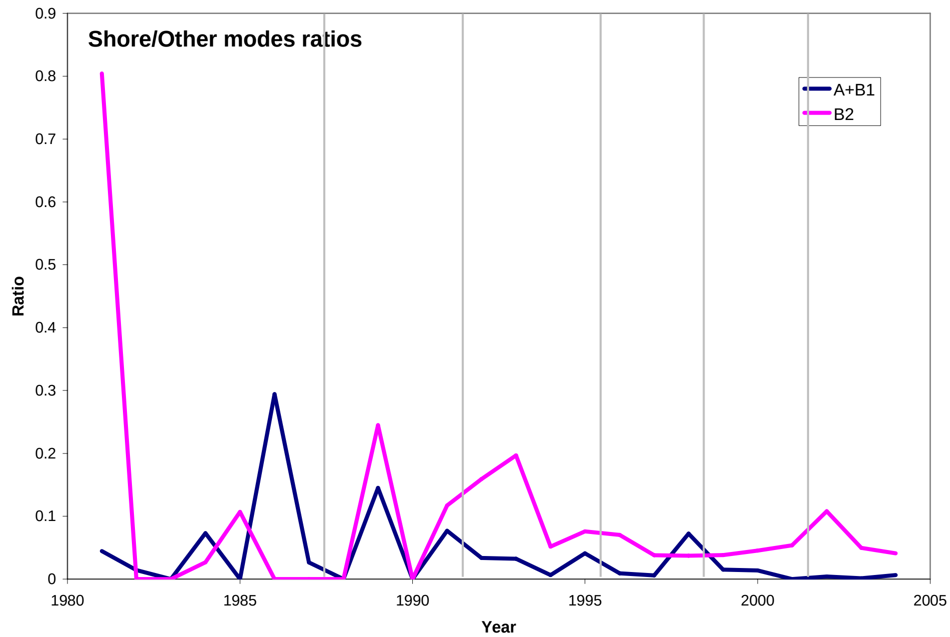
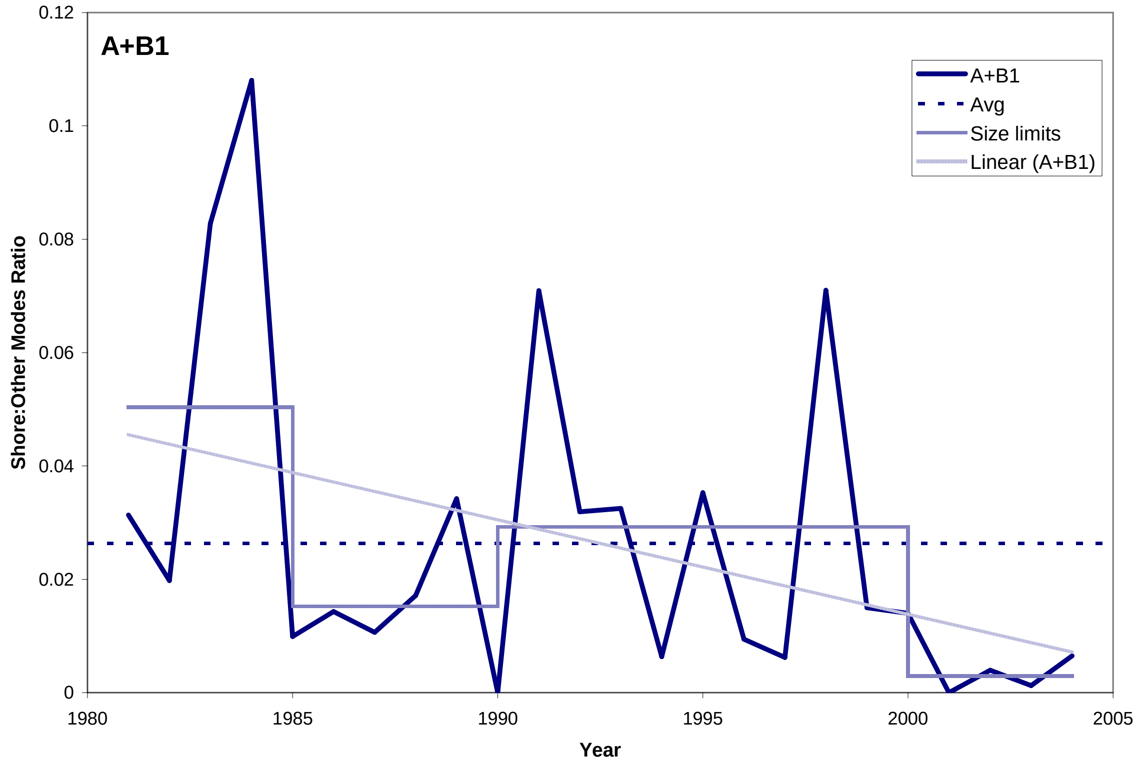


Fig. 2—MRFSS shore mode catches as a fraction of catches from other modes, including raw numbers and various potential substitutions. Raw values with expected years of high recruitment identified with gray vertical lines, assuming recruitment at 2.5 years old.

Therefore, alternatives were explored that would substitute general patterns for the annual estimates conventionally used. The goal was to explore methods for addressing the frequent criticism of large expansion factors in the MRFSS shore mode landings. All of the alternatives relied on replacing estimated shore catches with values generated by examining the ratio between shore and other modes. These alternatives included using a single constant ratio across all years, a ratio that varied as a linear function of time, and a distinct ratio for each period in which a size limits were in place. These alternatives are illustrated in Fig. 3a,b. These alternatives all assumed that the variability in this series is primarily statistical rather than representing true variation. The more general methods tended to reduce high early estimates and increase recent low estimates, although the method that used a constant for each time period for which a size limit was in place merely smoothed out both peaks and troughs.

Ultimately, the working group favored keeping the original data. Preference was given to using the annual estimates in their raw form and accounting for variability in the model itself. However, there was strong support for exploring this issue further in the future.



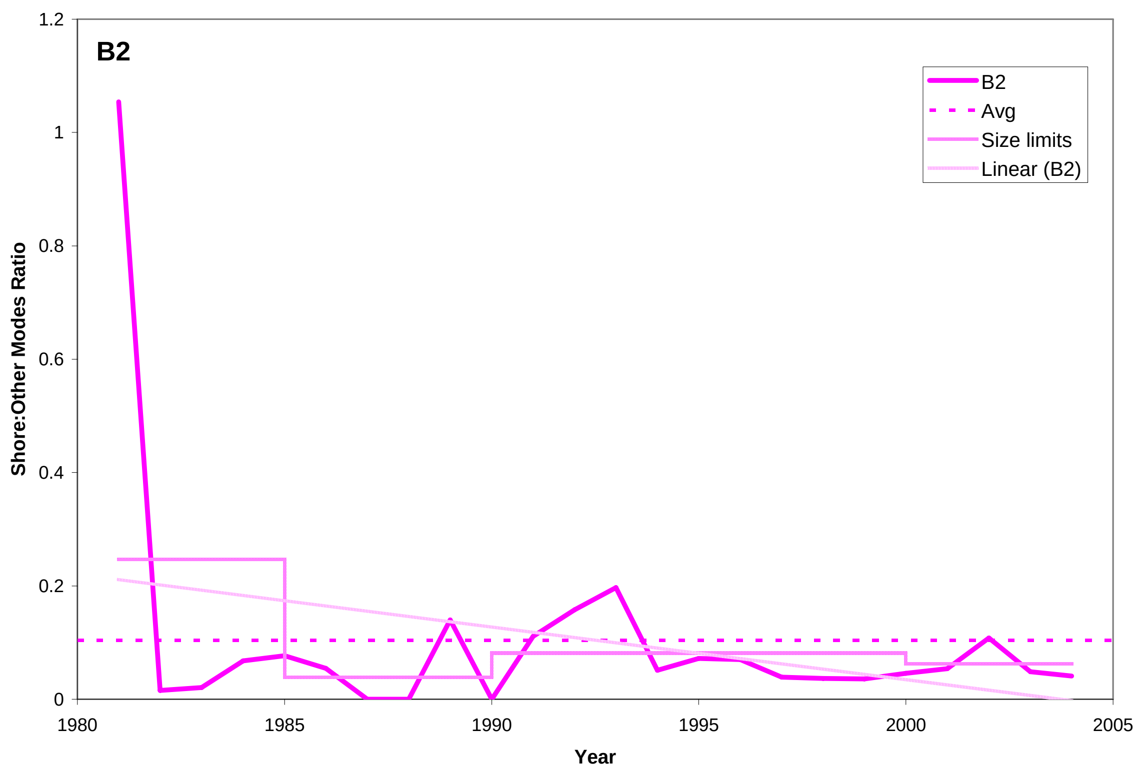


Fig. 3—MRFSS shore mode catches as a fraction of catches from other modes. (a) A+B1; (b) B2.

Charter boat effort

Prior to 1998, charter boat effort was estimated using angler phone surveys. Starting in 1998 interviews of charter boat captains, and the official estimates were based on these interviews starting in 2000. Fortunately, data were collected using both methods for the period 1998 to 2003. Diaz (SEDAR7-AW-03) examined these data using a generalized linear model that standardized across a range of tempo-environmental factors. The GLM analysis provided a correction factor for each stratum, which were then applied to effort records prior to 1998. These corrections were used by relevant strata to adjust the expansion factors for the charter boat mode in MRFSS. The effect of these adjustments was detailed in Phares et al. (SEDAR10-DW-26).

Wave 1, 1981

Data were not available for wave 1 in 1981. This gap was filled by determining the proportion of wave 1 to other waves in years 1982-1984 by fishing mode and area. These proportions were then used to estimate wave 1 in 1981 from the estimated catches in other waves of that year.

Results

Catches as estimated from MRFSS are shown by year, mode, and AB1 and B2 (Table 3). Note that these tables do not agree with the preliminary numbers (Phares et al., SEDAR10-DW-26) but reflect analyses as described above.

Table 3—MRFSS estimates by (a) mode, (b) State. Numbers of fish annually.

	Cbt		Cbt/Hbt		Priv		Shore		Total	
Year	ab1	b2	ab1	b2	ab1	b2	ab1	b2	ab1	b2
1981	.	.	77,396	35,814	166,657	85,271	7,646	127,636	251,699	248,721
1982	.	.	100,441	12,423	374,655	101,212	9,390	1,793	484,486	115,428
1983	.	.	171,428	21,201	749,945	397,264	76,261	8,734	997,634	427,199
1984	.	.	85,701	16,051	193,308	51,913	30,147	4,614	309,156	72,578
1985	.	.	514,010	54,167	348,935	91,392	8,560	11,188	871,505	156,747
1986	160,015	51,493	.	.	412,774	300,775	8,199	19,270	580,988	371,538
1987	32,335	17,240	.	.	340,164	206,969	3,956	0	376,455	224,209
1988	62,935	14,717	.	.	491,910	232,432	9,503	0	564,348	247,149
1989	34,803	18,614	.	.	297,381	411,529	11,366	60,108	343,550	490,251
1990	31,751	83,990	.	.	128,072	275,932	.	.	159,823	359,922
1991	12,706	1,838	.	.	228,289	781,550	17,088	86,914	258,083	870,302
1992	44,000	44,692	.	.	183,686	578,904	7,262	98,413	234,948	722,009
1993	100,569	91,818	.	.	220,214	982,654	10,436	211,888	331,219	1,286,360
1994	49,617	148,295	.	.	208,060	1,588,792	1,633	88,547	259,310	1,825,634
1995	107,010	190,853	.	.	283,921	1,530,169	13,792	123,789	404,723	1,844,811
1996	99,369	191,374	.	.	231,473	938,109	3,122	79,197	333,964	1,208,680
1997	94,892	181,141	.	.	278,850	1,460,361	2,315	63,964	376,057	1,705,466
1998	146,440	339,137	.	.	312,828	1,683,159	32,606	74,420	491,874	2,096,716
1999	126,939	209,575	.	.	382,531	1,207,813	7,630	50,876	517,100	1,468,264
2000	156,336	132,716	.	.	527,667	1,231,363	9,577	62,252	693,580	1,426,331
2001	105,071	142,127	.	.	356,723	1,678,443	0	98,240	461,794	1,918,810
2002	91,650	208,723	.	.	412,340	2,033,080	1,996	242,380	505,986	2,484,183
2003	94,330	286,968	.	.	392,208	2,941,048	605	157,079	487,143	3,385,095
2004	123,823	292,511	.	.	500,684	3,119,898	4,060	139,963	628,567	3,552,372

Table 3 (cont.)—MRFSS estimates by (a) mode, (b) State. Numbers of fish annually.

	LA		MS		AL		FL W		Total	
Year	ab1	b2	ab1	b2	ab1	b2	ab1	b2	ab1	b2
1981	.	.	.	.	7,255	0	244,444	248,721	251,699	248,721
1982	3,546	0	4,598	1,797	.	.	476,342	113,631	484,486	115,428
1983	2,912	0	.	.	2,436	0	992,286	427,199	997,634	427,199
1984	172	0	.	.	6	0	308,978	72,578	309,156	72,578
1985	6,319	0	.	.	34,782	0	830,404	156,747	871,505	156,747
1986	2,923	2,839	1,961	0	11,660	2,677	564,444	366,022	580,988	371,538
1987	4,018	0	2,443	0	842	0	369,152	224,209	376,455	224,209
1988	5,875	0	321	0	6	0	558,146	247,149	564,348	247,149
1989	4,277	0	906	235	614	0	337,753	490,016	343,550	490,251
1990	.	.	117	0	1,211	0	158,495	359,922	159,823	359,922
1991	1,983	0	0	0	1,990	471	254,110	869,831	258,083	870,302
1992	2,062	768	612	25	1,338	211	230,936	721,005	234,948	722,009
1993	2,399	2,653	2,159	165	3,040	3,699	323,621	1,279,843	331,219	1,286,360
1994	2,577	1,401	1,447	3,707	5,842	7,187	249,444	1,813,339	259,310	1,825,634
1995	830	186	20	4,851	7,976	9,679	395,897	1,830,095	404,723	1,844,811
1996	10,604	2,572	5,914	2,536	21,133	16,860	296,313	1,186,712	333,964	1,208,680
1997	1,022	2,018	299	1,263	11,751	8,150	362,985	1,694,035	376,057	1,705,466
1998	2,832	607	3,813	310	7,488	36,336	477,741	2,059,463	491,874	2,096,716
1999	17,104	6,647	489	5,602	22,943	77,965	476,564	1,378,050	517,100	1,468,264
2000	3,166	0	2,342	1,566	23,251	21,567	664,821	1,403,198	693,580	1,426,331
2001	4,198	3,054	19	1,888	8,435	11,334	449,142	1,902,534	461,794	1,918,810
2002	1,964	5,635	6,921	8,117	11,002	23,507	486,099	2,446,924	505,986	2,484,183
2003	1,776	5,250	296	81	11,125	31,006	473,946	3,348,758	487,143	3,385,095
2004	14,014	7,342	0	965	6,050	25,287	608,503	3,518,778	628,567	3,552,372

Headboat Survey

The Headboat Survey has been conducted in the Gulf of Mexico since 1986. Total catch by trip is reported in logbooks provided to all headboats in Gulf coast States and corrections for non-reporting are made by the survey. This survey was described more fully in Phares et al. (SEDAR10-DW-26). There were no controversial issues that came up in processing the headboat data for SEDAR10. Results are shown in Table 4.

Texas Parks and Wildlife Survey

Issues

Texas was included in MRFSS in 1981-1985, but only for shore mode in all years and boat modes in 1981 and 1985. However, catches of gag grouper were only encountered by MRFSS in Texas in one year, and those numbers were suspiciously high. The working group agreed that these catches should be considered an anomaly or error and excluded from the analysis. Instead, data were used that spanned 1983-2004 collected by the Texas Parks and Wildlife Department for boat modes together with the few MRFSS estimates. Shore mode in all years is considered 0 (not surveyed by TPWD, all zero in MRFSS 1981-1985, except the anomalous estimated discarded above).

Table 4—Headboat landings. Numbers of fish annually.

Year	TX	LA	AL-FLW	Gulf Total
1986	511	375	41,609	42,495
1987	548	261	31,347	32,156
1988	238	335	25,763	26,336
1989	174	66	34,905	35,145
1990	132	43	18,922	19,097
1991	151	10	11,292	11,453
1992	149	19	13,621	13,789
1993	329	260	18,746	19,335
1994	167	103	20,291	20,561
1995	182	167	17,467	17,816
1996	155	196	15,711	16,062
1997	142	81	15,400	15,623
1998	1,100	604	34,612	36,316
1999	235	484	31,398	32,117
2000	166	75	30,583	30,824
2001	147	50	14,297	14,494
2002	215	101	11,299	11,615
2003	327	147	15,907	16,381
2004	140	100	24,530	24,770

From 1986 to 2004, the TPWD data were considered complete for private and charter boats. However, there were numerous holes prior to 1986. No estimates were available for headboats in 1982-1984, and no boat mode estimates were made by either survey in 1982. MRFSS estimates in 1981 and 1985 for charter were all 0 but were incomplete for wave 4. We assumed charter boat catches were 0 in all years and that 500 fish were caught per year by headboats, equal to an average an approximate average of catches from the earliest years of data available, 1986 and 1987. Results are shown in Table 5.

Extending Recreational Catches Back in Time

Several alternatives were considered for extending estimates of recreational catches back in time. Since commercial catches are available back to at least until the early 1960s, it was desirable to identify a means to make reasonable estimates of recreational catches for the same time period. However, this exercise was made difficult by the fact that at best, we can only find patterns that fit recent years when recreational catches were available and hope those patterns held in earlier years.

We explored three possible relationships to recreational catches: a correlation with commercial catches, a relationship most likely driven by similar technological innovations and potentially by general interest in gag grouper; a correlation with coastal human populations, driven by numbers of potential anglers; and a linear relationship starting at a time when we expect the stock was close to unexploited, such as the end of World War II (i.e., 1945)

Table 5—Landings from Texas. Numbers of fish annually. Numbers prior to 1986 were filled in as indicated above. Note that there were no shore catches indicated in any year except 1984, and that year's data were considered unreliable. Headboat catches are accounted for in the Headboat Survey starting in 1986.

Year	Hb	Cbt	Priv	Total
1981	500	0	0	500
1982	500	0	27	527
1983	500	0	58	558
1984	500	0	19	519
1985	500	0	31	531
1986		313	0	313
1987		0	148	148
1988		0	0	0
1989		0	0	0
1990		50	19	69
1991		0	22	22
1992		0	0	0
1993		0	154	154
1994		90	116	206
1995		0	0	0
1996		134	520	654
1997		0	0	0
1998		431	53	484
1999		24	281	305
2000		92	263	355
2001		0	411	411
2002		0	141	141
2003		0	192	192
2004		313	0	313

Commercial catches were a good predictor of recreational catches over the period 1986 to 2004, based on preliminary results for both series (Figs. 4, 5). The correlation between commercial landings and total recreational catches (including MRFSS A, B1, and B2; headboat and Texas with estimated discards) produced a remarkably good fit ($R^2 = 0.5971$). Interestingly, this fit deteriorated when discards were not included because recreational discards have increased dramatically during this time period while landings stayed about the same. The strength of this relationship suggests that commercial catches prior to 1981 might help to estimate recreational catches during that period. However, it is generally believed that recreational effort has increased more dramatically than commercial effort in recent years.

Coastal human population also provided a good relationship to estimated angler trips, particularly in the private mode (Fig. 6). The group was concerned, though, that this relationship would not account for technological improvements that have intensified effective recreational fishing effort over the past few decades. As an alternative, there was support for a sensitivity analysis using a linear increase in recreational catches, starting at 0 in 1945 and ending at the average of 1981-83 catches in 1981. This relationship is illustrated in Fig. 7.

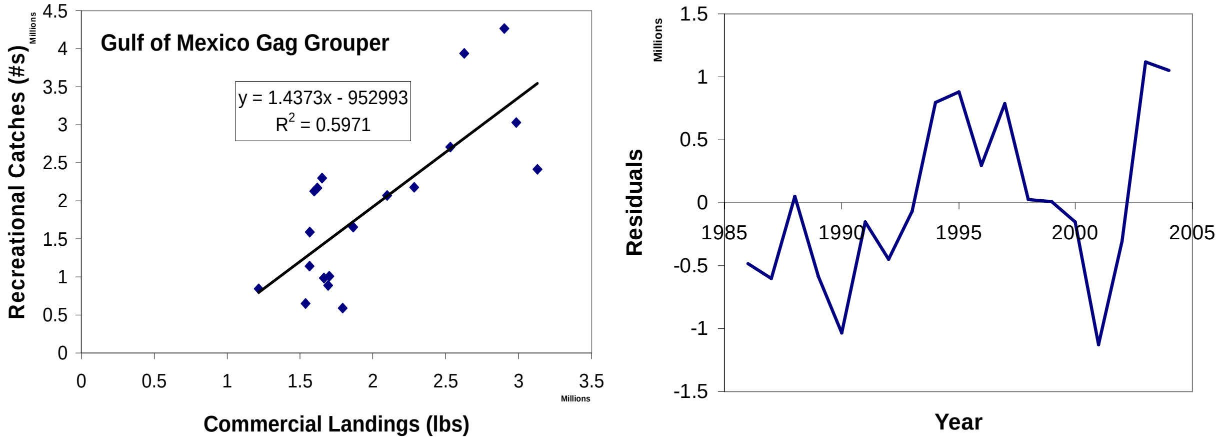


Fig. 4—Goodness of fit between commercial landings and recreational catches, 1986-2004. (a) Regression analysis. (b) Residuals over time.

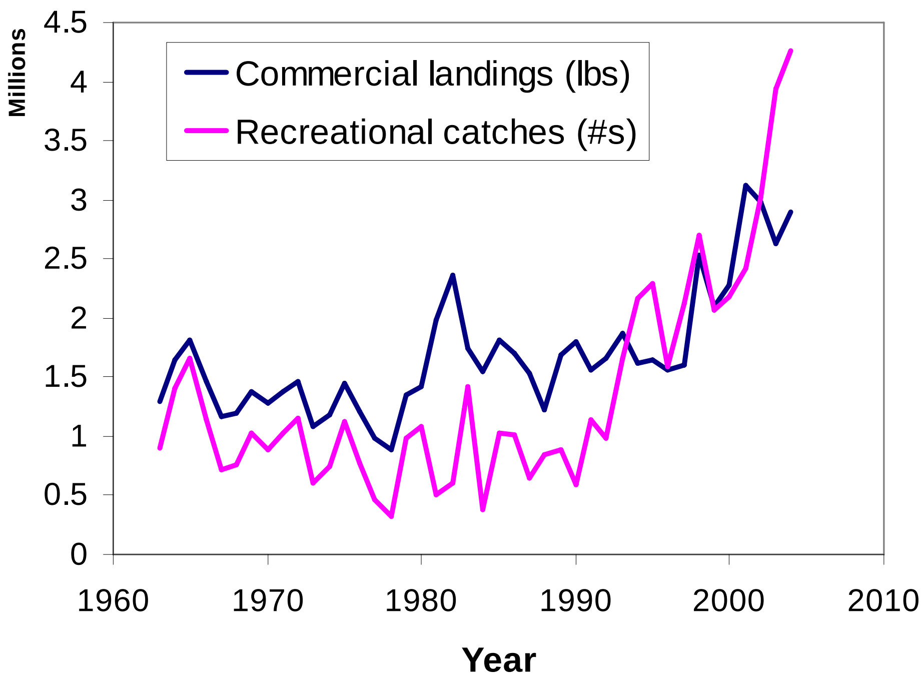


Fig. 5—Temporal pattern of commercial landings and recreational catches (including discards). The recreational catches include backward projection using a correlation to commercial landings.

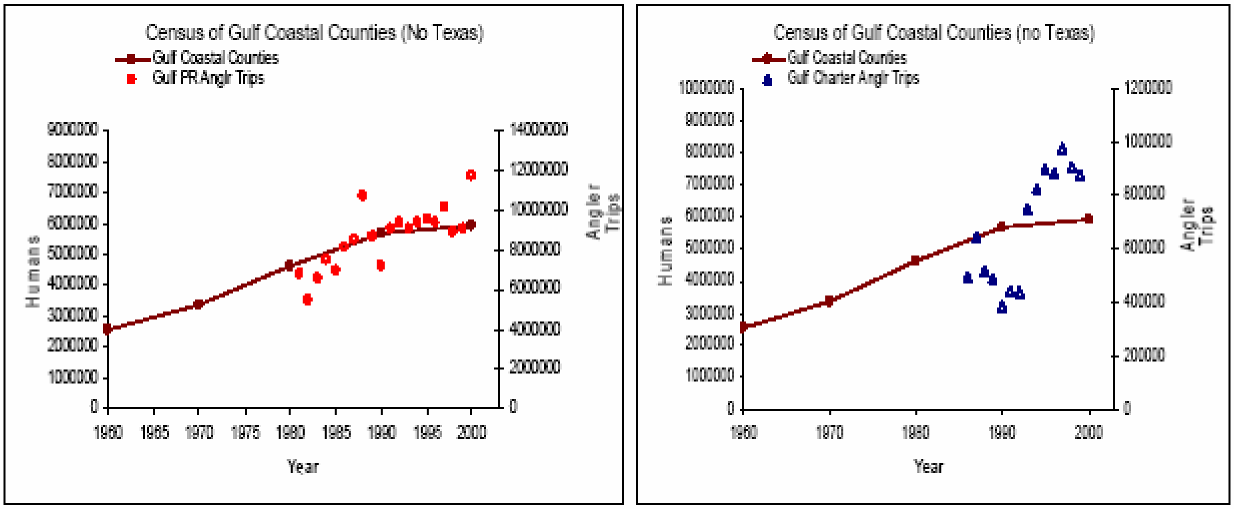


Fig. 6—Relationship between coastal human population and fishing effort (from Scott, SEDAR7-AW-16). (b) Linear increase in catches from 1963 to 1981, when data were available.

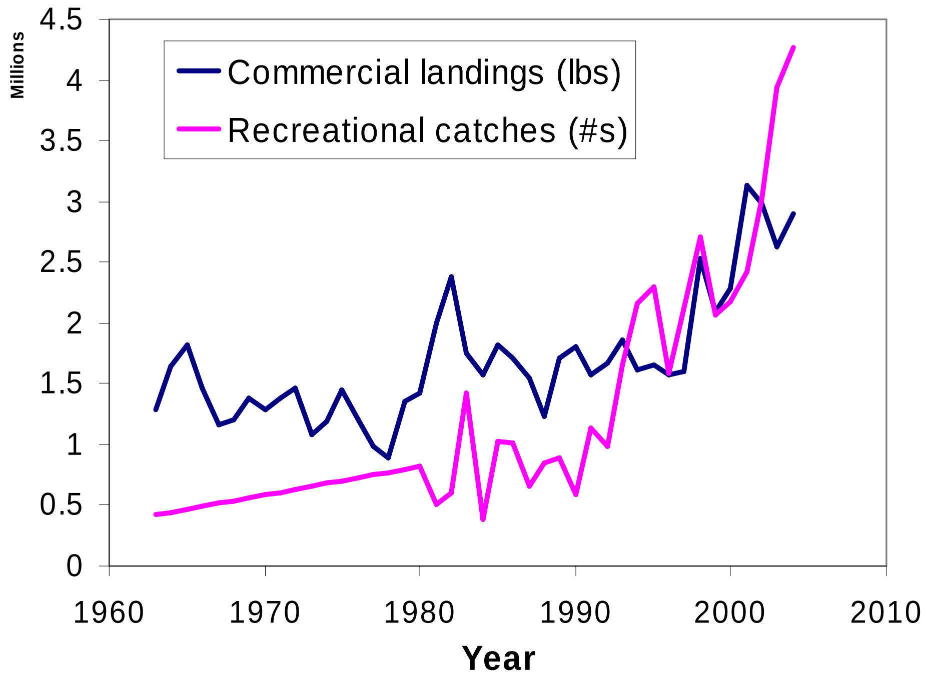


Fig. 7—Alternate temporal pattern of commercial landings and recreational catches (including discards). The recreational catches include backward projection using a linear decrease through time.

DISCARDS

General Issues

Typically, the only information we have to estimate discards in Gulf of Mexico recreational fisheries come from MRFSS. Consequently, the ratios of discards to landings are usually inferred from MRFSS data. Recently, two studies of headboat discards have allowed us to examine the validity of assigning MRFSS charter mode discard rates to headboat data. First, in 2004 the Headboat Survey began to collect information on discards. These data span Florida, Alabama, and Texas. Also, a new observer program collects discard information from Florida and Alabama, and these data were compared to MRFSS estimates as well.

Generally, the headboat and observer discard ratios corresponded well with the MRFSS charter mode discards (Table 6). The only major exception was from the Alabama observer program, which indicated substantially higher discards than the MRFSS survey. This discrepancy could theoretically be because the observer data was from 2005 and MRFSS data from 2004.

Table 6—Ratios of discards to kept gag grouper. Headboat data came from discard and retained fish records as identified in the headboat logbook program in 2004 in Florida, Alabama, and Texas. Observer program data came from headboat observers on vessels in Florida and Alabama in 2005. MRFSS Charter data come from the MRFSS survey using the ratio of B2 to A+B1 fish and include Florida, Alabama, and Louisiana (used as a proxy for Texas). The latter is the typical substitution used for headboats.

State	Headboat	Observer	MRFSS Charter
FL	2.73	3.73	2.42
AL	0.83	2.5	0.92
TX/LA	0.33	NA	0.58

TOTAL RECREATIONAL CATCHES

Based on the decisions outlined above, two series of recreational landings (AB1) and discards (B2) were developed. These are detailed in Table 7.

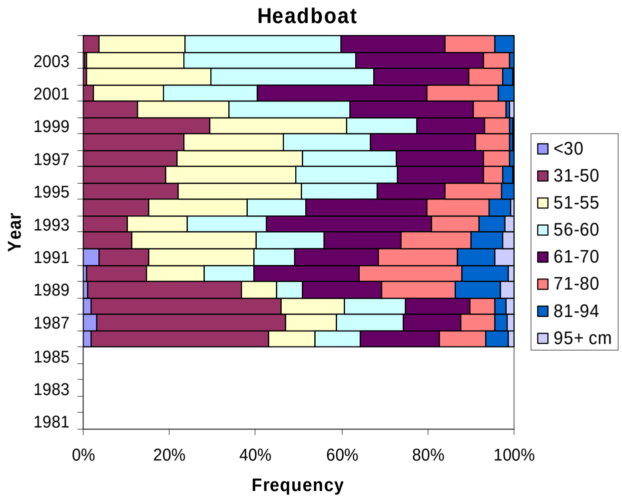
LENGTH FREQUENCY DISTRIBUTIONS

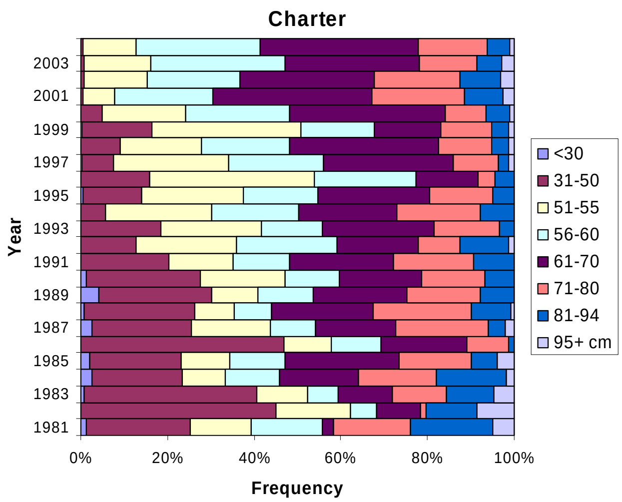
Length data were available from intercepts of recreational fishing activity covering all modes (shore, headboat, charter, and private). These data were processed independently for each mode and year. Because length samples were sparse for some of the MRFSS modes, the modes were combined weighting each by the corresponding landings from each mode in each year. These data were converted to age distributions using the same slicing algorithm as the previous assessment (Turner et al., 2001), and presented elsewhere (SEDAR10-AW-Report).

Results of length frequency analyses are shown by mode in Fig. 8. The aggregated recreational length frequencies, with modes weighted by total landings, are shown in Fig. 9.

Table 7—Total recreational catches and discards for Gulf of Mexico gag grouper. Numbers of fish annually.

Year	BASE: Commercial Correlation		ALT: Linear Increase from 1945-	
	Landed (AB1)	Released (B2)	Landed (AB1)	Released (B2)
1963	897,426	0	421,125	0
1964	1,402,629	0	444,521	0
1965	1,633,054	20,672	462,068	5,849
1966	1,105,826	32,558	477,261	14,052
1967	685,807	32,090	491,701	23,007
1968	716,539	46,386	505,388	32,717
1969	947,211	78,909	518,321	43,179
1970	808,652	82,916	530,501	54,395
1971	913,607	111,881	541,927	66,365
1972	1,004,122	143,708	552,601	79,087
1973	518,580	85,333	562,521	92,563
1974	629,229	117,542	571,687	106,793
1975	932,903	195,836	580,100	121,775
1976	630,922	147,610	587,760	137,511
1977	363,933	94,248	594,666	154,001
1978	246,253	70,186	600,820	171,244
1979	753,062	235,079	606,219	189,240
1980	807,650	274,991	610,866	207,989
1981	252,199	248,721	252,199	248,721
1982	485,013	115,428	485,013	115,428
1983	998,192	427,199	998,192	427,199
1984	309,675	72,578	309,675	72,578
1985	872,036	156,747	872,036	156,747
1986	623,483	385,172	623,483	385,172
1987	408,924	241,070	408,924	241,070
1988	590,684	253,338	590,684	253,338
1989	378,695	509,130	378,695	509,130
1990	179,068	410,624	179,068	410,624
1991	269,605	872,238	269,605	872,238
1992	248,737	735,921	248,737	735,921
1993	350,576	1,303,751	350,576	1,303,751
1994	280,025	1,887,900	280,025	1,887,900
1995	422,539	1,876,261	422,539	1,876,261
1996	350,232	1,239,252	350,232	1,239,252
1997	391,680	1,735,041	391,680	1,735,041
1998	528,844	2,176,986	528,844	2,176,986
1999	549,701	1,520,276	549,701	1,520,276
2000	724,709	1,452,424	724,709	1,452,424
2001	476,643	1,938,186	476,643	1,938,186
2002	518,012	2,510,810	518,012	2,510,810
2003	503,665	3,434,530	503,665	3,434,530
2004	653,528	3,610,622	653,528	3,610,622





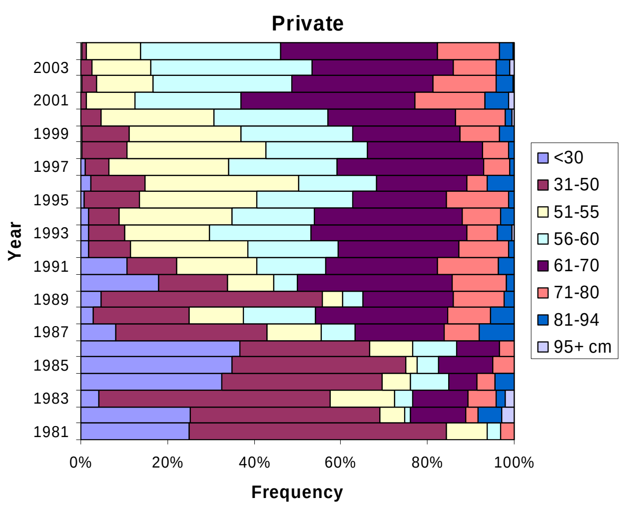


Fig. 8—Length frequencies by year and mode (AB1). Size bins are identical in each figure to facilitate comparisons.

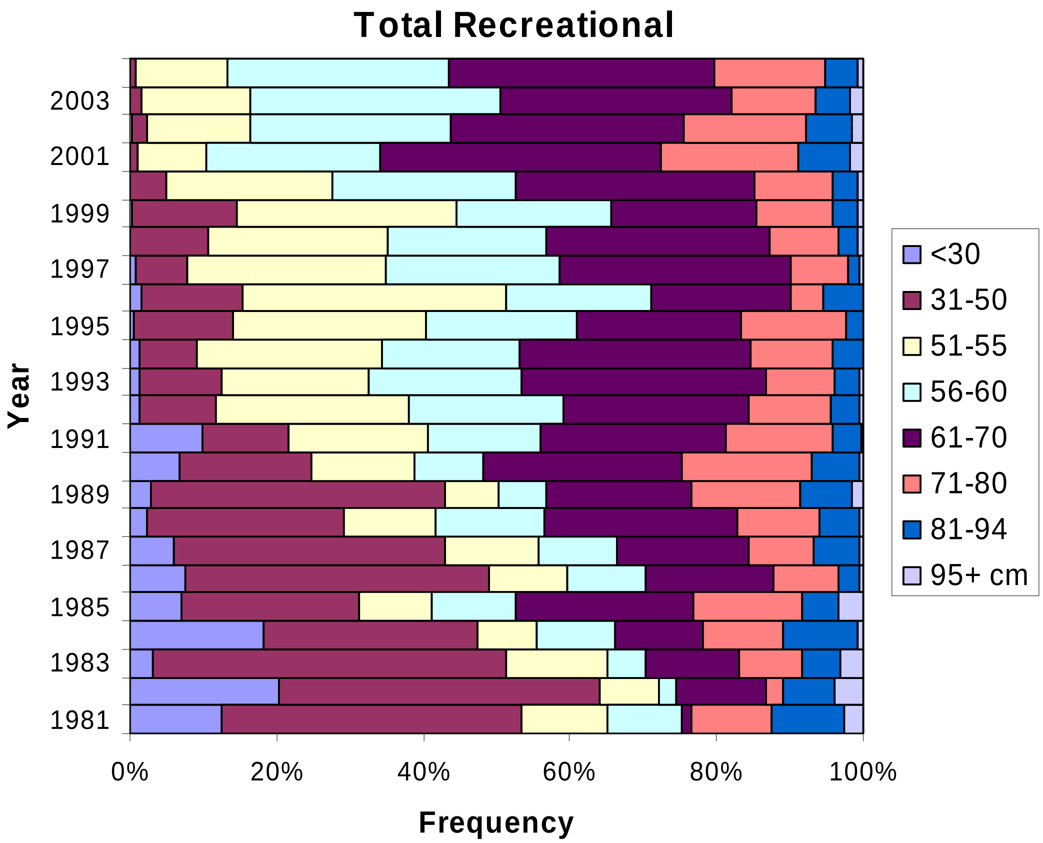


Fig. 9—Length frequency distributions over time from all recreational sources (AB1). Note early loss of the largest length bin and its reemergence in recent years, and drops in smaller size bins with the implementation of size limits in 1985 (18 in. TL), 1990 (20 in TL = 51 cm FL), and 2000 (22 in TL = 56 cm FL).

RESEARCH RECOMMENDATIONS

The group developed three research recommendations. First, we recommended a closer examination of reported headboat fishing locations, with respect to the GMFMC-SAFMC dividing line. Comparing their location reporting pre-1986 when compliance was high to post-1986 when it dropped might shed some light on whether these data are representative. Second, the group suggested that we explore whether there might be good surrogates for recreational fishing effort, for example numbers of recreational boat licenses or numbers of operating headboats. These might be especially valuable for backward projections of catches. Finally, the group recommended that MRFSS shore mode be explored further to elucidate whether it provides a useful annual signal of catches.

REFERENCES

Turner, SC, CE Porch, D Heinemann, GP Scot, M Ortiz. 2001. Status of Gag in the Gulf of Mexico, Assessment 3.0. Sustainable Fisheries Division Contribution: SFD 01/02-134. Department of Commerce, NOAA/NMFS, Southeast Fisheries Science Center, Miami, FL. 156 p.

5. INDICES OF ABUNDANCE

Table 5-1 summarizes the available indices for gag grouper in the U.S. Gulf of Mexico. The recommendations of the SEDAR10 DW index of abundance working group are described in detail below.

Table 5-2 is a summary of the pros and cons associated with each index.

The recommended indices and their associated variances are summarized in Table 5-3 and 5-4.

5.1 FISHERIES DEPENDENT INDICES

In the following discussion, fishing locations are often referenced by shrimp statistical grid. These are illustrated in Figure 5-1.

There is evidence that gag grouper are often misreported as black grouper, particularly in South Florida and the Florida Keys (SEDAR10-DW-24 with the exception of Monroe County (Florida Keys), where gag grouper are seldom misidentified. This issue affects the construction of most fisheries dependent indices, and was addressed in various ways by the index working group. The group decisions are summarized for each index below.

5.1.1 COMMERCIAL HANDLINE

General Description:
The construction of the commercial handline indices is described in the document SEDAR10-DW-10.

The NMFS Gulf of Mexico Reef Fish Logbook Program collects catch and effort data by trip for permitted vessels since 1990. Data include complete census of commercial reef fish trips by vessels permitted in TX, LA, MS, AL and FL. However, between 1990 and 1993 only 20% sample of vessels permitted in FL were required to submit logbooks. The logbook data include unique trip and vessel identifiers, and information regarding trip date, gear class, fishing area (shrimp statistical grids), days at sea, fishing effort, species caught and landed weight.

Methods:
Logbook data were restricted to statistical grids 1-11. Gag grouper handline trips were defined as trips that fished under the following conditions; a) with 10 or fewer hooks per line, b) six or fewer lines fished, c) were at sea for 15 or fewer days, and d) had crews of four or less. Trips that fished during gag or shallow-water grouper closures were excluded from the analysis. Nominal catch rates were estimated as pounds landed per hook-hour fished.

Three indices of abundance for the commercial handline Gulf fishery were presented to the index working group (SEDAR10-DW-10). Indices were constructed for the period 1993-2004, for the period 1993 – June 2000, and for the period July 2000 – 2004, in response to changes in minimum size regulations.

Recommendations/Issues Discussed at Data Workshop:

1. To address the problem of gag grouper misreported as black grouper: the group recommended that areas with high proportion of black grouper (areas 1 and 2) be dropped from the Gulf of Mexico analyses. In areas 3-11, the group decided that all black grouper were likely misreported, and should be assumed to be gag grouper.

2. The group discussed the appropriateness of including coastal logbook data from 1990-1992 in the handline commercial indices. Data from those years were excluded from the initial indices developed in SEDAR 10-DW10 because in Florida only a 20% subsample of the vessels reported during those years. Differences in CPUE by vessels reporting to the logbook program during 1990-1992 and vessels reporting in later years were examined. Little difference was observed in mean yearly CPUE among the two groups of vessels during the years when all the vessels were reporting to the logbook program. The working group found no valid reason to exclude data from 1990-1992.

3. The state of Florida imposed an 18" minimum size limit for GAG in 1985. This limit was raised to 20' on February 21, 1990. After reviewing the data, it appears that there were very few reported trips that occurred before the imposition of the 20" minimum size limit. Therefore, the group recommends that the analysis dataset be restricted to trips occurring after Feb. 21, 1990.

4. The group recommended that gag and shallow-water grouper closures be handled by excluding all trips that occurred during February 15th to March 15th each year (even though the reproductive closure began in 2001), and by excluding trips that occurred during the shallow-water grouper closure from Nov. 15th – Dec.31st, 2004. The group felt that this treatment would improve the statistical quality of the GLM fits to the data.

5. The working group discussed the "gear selection" criteria for defining gag grouper trips. It was suggested to use a multispecies method approach (Stephens and MacCall, 2004) similar to the criteria used for the Atlantic logbook commercial data.

6. The group recommended that year*factor (e.g. year*fishing area) interaction terms be excluded from the GLMs used during index construction. There was concern that these terms, which were modeled as random effects, inflate the variance to such an extent that the trend in catch rates/abundance is essentially nullified.

Results:

Revised indices were constructed based on the recommendations of the SEDAR10-DW index of abundance working group. These are discussed in detail in appendix 1 of the revised document SEDAR10-DW-10.

The recommended commercial handline indices are summarized in Table 5-3 and Figure 5-2. The indices indicate a 3-fold increase in the standardized catch rates of gag grouper during the period 1990 to 2004. This result could be caused by an increase in abundance, or by improvements in gear efficiency or ability to target quality fishing locations (catchability).

Length frequency histograms of gag observed from commercial handline trips by TIP agents are reported in SEDAR10-DW-23. Typically, the commercial handline fishery catches gag larger than the legal minimum size (20" effective Feb 21st 1990; 24" effective June 19th 2000), and smaller than 48 inches, although gag larger than 44 inches are rarely observed. Changes in the mean size of gag are apparent during the time series (SEDAR10-DW-23).

Utility:
The SEDAR10-DW index of abundance working group recommends the use of the commercial handline index, with the following stipulations:

1. The group recommends the use of the indices constructed using the multispecies method to subset observations based on the catch composition (e.g. Stephens and MacCall, 2004).

2. When changes in selectivity can be accounted for in the assessment model using available size or age frequency data, use the 1990-2004 index, without breaking the index at the change in the minimum size limit (June 19th 2000).

3. If changes in selectivity cannot be accounted for in the assessment model (e.g. VPA), consider the use of the broken indices (1990-2000 and 2000-2004). However, the working group has expressed a concern that some information regarding abundance is lost when indices are broken, particularly if abundance is changing at the discontinuity.

4. Potential changes in catchability should be addressed (see research recommendation 4).

These recommendations were presented to, and accepted by the SEDAR10-DW plenary.

5.1.2 COMMERCIAL LONGLINE

General Discussion:
The general discussion regarding the data source can be found in section 5.1.1.

Methods:
Three delta-lognormal indices were presented to the Data Workshop (SEDAR10-DW-18). The first considered the period 1993-2004 without considering the amended size limit (effective date June 19th, 2000). The second was constructed for the period of the 20" size limit (Feb 21st to June 18th 2000), and the third was constructed for the 24" size limit (June 19th, 2000 to Dec. 2004). For each index, the following factors were considered as possible influences on the proportion of trips that observed gag grouper, and the catch rates on positive trips: year, shrimp statistical grid (areas 1&2, 3-8, 9&10), season (Dec-Feb, Mar-May, Jun-Aug and Sep-Nov), and trip length (1-5 days, 6-10 days, >10 days). The proposed indices suggested increasing catch rates during the time series.

Issues Discussed at Data Workshop:

1) Include 1990-1992 during index construction. The proposed indices had been constructed beginning in 1993 due to partial sampling (20%) off Florida during 1990-1992. Beginning in 1993, all permitted reef fish vessels were required to submit logs. The group was advised that the 20% sample was achieved by requesting every fifth

person to receive a permit submit a logbook. The group was satisfied that this procedure was essentially random, although the group recognized that compliance may be non-random.

2) The state of Florida imposed a 18” minimum size limit for GAG in 1985. This limit was raised to 20’ on February 21, 1990. After reviewing the data, it appears that there were very few reported trips that occurred before the imposition of the 20” minimum size limit. Therefore, the group recommends that the analysis dataset be restricted to trips occurring after Feb. 21, 1990.

3) Species-misidentification. To avoid errors in species identification, the group recommended that the analysis dataset be restricted to shrimp statistical grids 3 to 11, and that all black grouper reported within these areas be assumed to be gag. According to Trip Interview Program (TIP) observer data, the proportion of gag+black groupers that are actually gag is 85% in area 3, and greater than 95% in areas 4-10. In addition, areas 3-11 include more than 95% of the landings.

4) The group recommended that gag and shallow-water grouper closures be handled by excluding all trips that occurred during February 15th to March 15th each year (even though the reproductive closure began in 2001), and by excluding trips that occurred during the shallow-water grouper closure from Nov. 15th – Dec.31st, 2004. The group felt that this treatment would improve the statistical quality of the GLM fits to the data.

5) The group recommends that an additional index be constructed that restricts the longline analysis dataset to trips identified by the species composition approach described by Stephens and MacCall (2004).

6) The group recommended that year*factor (e.g. year*fishing area) interaction terms be excluded from the GLMs used during index construction. There was concern that these terms, which were modeled as random effects, inflate the variance to such an extent that the trend in catch rates/abundance is essentially nullified.

Results:

Revised indices were constructed based on the recommendations of the SEDAR10-DW index of abundance working group. These are discussed in detail appendix 1 of the revised document SEDAR10-DW-18.

The recommended commercial longline indices are summarized in Table 5-3 and Figure 5-2. The indices indicate a 2.5-fold increase in the standardized catch rates of gag grouper during the period 1990 to 2004. This result could be caused by an increase in abundance, or by improvements in gear efficiency or ability to target quality fishing locations (catchability).

Length frequency histograms of gag observed from commercial longline trips by TIP agents are reported in SEDAR10-DW-23. Typically, the commercial longline fishery catches gag larger than the legal minimum size (20" effective Feb 21st 1990; 24" effective June 19th 2000), and smaller than 48 inches.

Utility:
The SEDAR10-DW index of abundance working group recommends the use of the commercial longline index, with the following stipulations:

1. The indices constructed using the Stephens and MacCall procedure are not recommended due to the high proportion of positive trips (>83% each year).

2. When changes in selectivity can be accounted for in the assessment model using available size or age frequency data, use the 1990-2004 index, without breaking the index at the change in the minimum size limit (June 19th 2000).

3. If changes in selectivity cannot be accounted for in the assessment model (e.g. VPA), consider the use of the broken indices (1990-2000 and 2000-2004). However, the working group has expressed a concern that some information regarding abundance is lost when indices are broken, particularly if abundance is changing at the discontinuity.

4. Potential changes in catchability should be addressed (see research recommendation 4).

These recommendations were presented to, and accepted by the SEDAR10-DW plenary.

5.1.2 HEADBOAT SURVEY

General Discussion:
Rod and reel catch and effort from party (head) boats in the Gulf of Mexico have been monitored by the NMFS Southeast Zone Headboat Survey (conducted by the NMFS Beaufort Laboratory) since 1986. The Headboat Survey collects data on the catch and effort for a vessel trip. Reported information includes landing date and location, vessel identification, the number of anglers, fishing location, trip duration and/or type (half/three-quarter/full/multi-day, day/night, morning/afternoon), and catch by species in number and weight.

Material and Methods:
Abundance indices were developed for Gulf of Mexico gag using data from the NMFS Southeast Zone Headboat Survey. This index spanned from 1986 to 2004, with large sample sizes each year. Based upon the typical geographic distribution of gag, three zones having relatively high catch rates were defined off the Florida and Alabama coasts. The analysis was restricted to data from these three zones in order to reduce variance and to avoid potential difficulties with possible species identification confusion with black grouper, which occur with greater frequency south of the designated areas. Also to reduce variance, the Stephens and MacCall (2004) species association approach was used to identify trips that were likely to catch gag based on the composition of other species landed.

An 18" minimum size limit was imposed by the State of Florida in 1985. Headboat data is available beginning in 1986. Based upon size frequency distributions from the headboat dataset, it appeared likely that the imposition of a 20 inch TL minimum size limit in February

1990 and a later 22 inch TL minimum size limit in June 2000 likely influenced discard rates, which are not recorded in the Headboat Survey data during most of the time period. As a consequence, indices were constructed for three periods corresponding to the various size limits (18”FL: 1986-1989; 20”GOM: 1990-2000 and 24”GOM: 2000-2004) within which discard rates were expected to have remained relatively consistent from year to year. An index for the entire time period (1986-2004) was also constructed.

For each set of data, a model was constructed, assuming a delta-lognormal error distribution, was constructed considering the following factors: year, zone, vessel, month, season (WINTER=Dec.-Feb., SPRING=Mar.-May, etc.), trip category (TRIPCAT: half day/3qtr-full day/multi day), and whether the fishing occurred during the day or night (DAYNIGHT: day/night/unknown). The CPUE unit was number pf gag per angler hour.

Issues discussed at the Data Workshop:

1. To review the effect of misreporting of gag and black groupers, the group examined indices constructed two ways: 1) assuming that no misreporting occurred, 2) assuming that all black grouper were misreported, and were actually gag. The two indices were not notably different. Therefore, the group supported the author’s assumption that black and gag grouper are rarely misidentified or misreported in the headboat data, and no corrections to species identification were required.

2. The group recommended that the South Atlantic and Gulf indices be constructed with similar units of effort (angler*hours, or anglers, unless scientifically inadvisable. The group decided that catch per angler hour was most appropriate for use in the Gulf and South Atlantic.

3. The group recommended that the source data be examined for vessels that fail to report data correctly since the 2004 revision of the survey form (to include discard information).

4. The group recommended that year*factor (e.g. year*fishing area) interaction terms be excluded from the GLMs used during index construction. There was concern that these terms, which were modeled as random effects, inflate the variance to such an extent that the trend in catch rates/abundance is essentially nullified.

Results:

Revised indices were constructed based on the recommendations of the SEDAR10-DW index of abundance working group. These are discussed in detail in document SEDAR10-DW-4.

The recommended headboat indices are summarized in Table 5-3 and Figure 5-2. The indices suggest that, for the headboat fishery, standardized catch rates of gag grouper varied without obvious trend during the period 1986 to 2004. Temporary reductions in catch rates, followed by steadily increasing catch rates may be due to increases in the minimum legal size (to 20” in 1990; 24” in 2000).

Length frequency histograms of gag observed from headboat trips are pending.

Utility:
The SEDAR10-DW index of abundance working group recommends the use of the headboat index, with the following stipulations:

1. When changes in selectivity can be accounted for in the assessment model using available size or age frequency data, use the 1986-2004 index, without breaking the index at the change in the minimum size limit.

2. If changes in selectivity cannot be accounted for in the assessment model (e.g. VPA), consider the use of the broken indices. However, the working group has expressed a concern that some information regarding abundance is lost when indices are broken, particularly if abundance is changing at the discontinuity.

3. Potential changes in catchability should be addressed (see research recommendation 4).

These recommendations were presented to, and accepted by the SEDAR10-DW plenary.

5.1.3 MARINE RECREATIONAL FISHERIES STATISTICAL SURVEY (MRFSS)

General Description:
Data collected and estimated by the Marine Recreational Fisheries Statistical Survey (MRFSS) were used to develop standardized catch per unit effort (CPUE) indices for gag stocks of the Gulf of Mexico. The recreational fisheries survey started in 1979, and its purpose is to establish a reliable database for estimating the impact of marine recreational fishing on marine resources. More detailed information on the methods and protocols of the survey can be found at http://www.st.nmfs.gov/st1/recreational/overview/ overview.html.

Methods:
Catch and effort data from the MRFSS survey was used to generate standardized relative indices of abundance for Gulf of Mexico gag (SEDAR10-DW-9).

Discussion regarding the use of MRFSS catch and effort data for creating indices of abundance for the Atlantic and Gulf of Mexico gag stocks center on two main issues: a) the selection of trip/interview records that have a positive likelihood of capturing gag, and b) the discussion of misreporting gag as black grouper in MRFSS records.

Data included trip/interview records from the Florida west coast to Louisiana. Gag nominal catch rates (number of fish caught AB1B2 per number of angler-hours) were standardized following a delta modeling approach as the proportion of trip/interviews that reported gag catches were low (~ 1%). The model assumed a binomial distribution for the proportion of positive trips and a lognormal distribution for the catch rates of positive gag trips. Factors evaluated in the model were mode (shore, charter, private/rental), area (inshore, ocean < 3 miles, 3 < ocean < 10 miles, ocean > 10 miles), region (Central Gulf; Louisiana, Alabama, Mississippi, and Western Gulf; Florida west coast), season (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec), and guild (inshore species, reef species, non-reef species, and pelagic species, unclassified). The last factor guild, classifies trips according to the intended target species of the trip, as declared by the angler. If no target was declared, the trip was assigned as unclassified. The standardization model evaluated interactions between factors.

The analyses also investigated two alternative methods to select trip/interview records from the MRFSS data that have higher likelihood or probability of catching gag. These methods were based on analysis of the species typically associated with gag catches. Red grouper and reef snappers show up as the most common species with gag catch. Method one selected trip/interviews records for which the angler reported a target species, and this species belonged to one of the following guilds: reef, non-reef and pelagic. Method two used a multispecies logistic regression approach that predicted a likelihood of catching gag and defined a threshold probability value to accept trip/interview records (Stephens and MacCall 2004). When applied to Gulf of Mexico gag, method two (multispecies logistic regression) converged to a solution but rejected about 98% of the records in the MRFSS database. Trends and estimated 95% confidence bounds were similar for all data subsets.

Issues discussed at the Data Workshop:

1) With regard to species misidentification or misreporting, the Data Working SEDAR10 group recommended adjusting Gulf recreational catches of gag grouper and derived indices. The group recommended that standardized catch rates be adjusted for gag misidentified/misreported as black grouper by excluding from the analysis areas of south west Florida corresponding to the Shrimp-statistical areas 1 and 2, and by assuming the all black grouper in other areas are actually gag grouper that have been misreported.

2) The group does not recommend the use of the Stephens and MacCall (2004) species composition method as applied to the MRFSS index of gag grouper. The Stephens and MacCall method is most appropriately applied to fishing trips that typically land a number of species on a single trip. This is generally not the case in the MRFSS dataset, and this can confound estimation of the threshold required for the procedure.

3) The group recommended that year*factor (e.g. year*fishing area) interaction terms be excluded from the GLMs used during index construction. There was concern that these terms, which were modeled as random effects, inflate the variance to such an extent that the trend in catch rates/abundance is essentially nullified.

Results:

Revised indices were constructed based on the recommendations of the SEDAR10-DW index of abundance working group. These are discussed in detail appendix 1 of the revised document SEDAR10-DW-9.

The recommended MRFSS index is summarized in Table 5-3 and Figure 5-2. The index is quite variable, but indicates a general increase in the standardized catch rates of gag grouper, particularly during the period 1987 to 2004. As the MRFSS dataset contains observations of gag landed, discard dead and released alive, the index is less likely to be influenced by management measures. Therefore, it is not necessary to construct separate indices for the various minimum size limits and bag limits. However, as this index is fisheries dependent, it may still be influenced by changes in catchability.

Utility: The group recommends the use of the MRFSS Recreational Index, with the caveat that potential changes in catchability be addressed (see research recommendation 4).

5.2 FISHERIES INDEPENDENT INDICES

5.2.1 SEAMAP VIDEO SURVEY

The SEAMAP Video Survey is described in SEDAR10-DW-12. Three indices of abundance were constructed, a gulfwide index, an eastern Gulf index and an index of "Copper-belly" gag which are predominately male.

Methods:

- Two-stage sampling design
  - First-stage is made up of blocks 10 minutes of latitude by 10 minutes of longitude, selected by stratified random sampling
  - Second-stage units within a block are selected randomly.
- Random 20-minute sections of videos were reviewed.
- Mincount (i.e., maximum number of fish on the video image at any one time during 20 minute viewing) was recorded for all gag and for those with darkly pigmented ventral surfaces (i.e., copper-belly gag or CBG).
- Delta-lognormal model used to develop abundance index from mincount data.
  - Parameters tested for inclusion in each sub-model were region, year, stratum, and block nested within stratum, station depth.
  - The estimates from each model were weighted using the stratum area, and separate covariance structures were developed for each survey year.

Results:

The recommended index is summarized in Table **5-4** The relative index in compared to other fisheries-independent indices in Figure **5-3.**

- Three models converged.
  - Gag Gulfwide index
    - Parameters retained binomial model: year, region and station depth
    - Parameters retained lognormal model: year
  - Gag East Gulf Index
    - Parameters retained binomial model: year and station depth
    - Parameters retained lognormal model: year
    - Mean annual nonzero mincount estimates not significantly different and all close to one indicating that the binomial portion of the model would provide a useful abundance index.
  - CBG East Gulf Index
    - Parameters retained zero-inflated binomial model: year and station depth
    - Parameters retained lognormal model: year

        - Mean annual nonzero mincount estimates only significantly different for 2002 and all were close to one indicating that the zero-inflated binomial portion of the model may provide a useful abundance index.
        -
- Size of gag observed in videos
    - 50 gag were hit by lasers, indicating sizes ranging from 400 to 1000 mm TL, with the majority of individuals falling between 600 and 775 mm TL.

Issues Discussed at Data Workshop:

1) Gulf-wide index: not appropriate due to extremely low occurrence of gag in the western Gulf. This is an essentially eastern index.

2) Eastern Index: Catch on positive trips is generally very close to one fish, indicating that the binomial portion of the model would provide a useful abundance index. This is essentially a presence/absence index.

3) Copper-Belly Index. Copper-Belly gag is a color morph that is predominately male. Although this index may not be proportional to the entire population of gag grouper, it may be possible to use it to index the abundance of males, or plus group animals, assuming that an age-structured model is used. ***CAUTION:*** Copper-bellies are included in the Eastern SEAMAP Video Survey index. A recalculated index excluding the copper-bellies is pending.

Utility:

The group recommends the use of the eastern video survey index. The group also recognized that the copper-belly index is suitable to index the number of males (or the abundance of the plus group) if an age structured model is used during assessment procedures.

The group ***provisionally*** recommends the use of the “Copper-Belly” index to estimate the abundance of males, or the plus group during sensitivity runs. To use this index, an age structured assessment model is necessary, and the selectivity of the copper-belly index must be parameterized to index the appropriate age classes. Also, the eastern video index must be reconstructed excluding the copper-bellies to allow the simultaneous use of the two indices. The reconstructed video index is pending.

5.2.2 Florida Estuaries Index (FMRI):

General Discussion:

An index of abundance was constructed using gag abundance and habitat data collected throughout Florida estuaries including: Apalachicola Bay, Cedar Key, Tampa Bay, Charlotte Harbor, Southern Indian River Lagoon, Northern Indian River Lagoon, and Northeast Florida (St. Johns, Nassau, and St. Marks Rivers) (SEDAR10-DW-30). The data were collected by the Florida Fish and Wildlife Conservation Commission (FWC), Fish and Wildlife Research Institute’s Fisheries-Independent Monitoring program, and are available from 1996 to 2004.

Methods:

Monthly stratified-random sampling was conducted during the day by using three different seines. The estuaries were divided into 1 x 1 nautical-mile cartographic grids (1 nm^2), and grids with appropriate water depths for each seine were selected as the sampling universe. Samples were stratified by depth and habitat type depending on gear. Due to the extremely low occurrence of gag in other gears, only the data from samples collected with the 183-m center-bag haul seine (183 m x 3 m, 37.5-mm stretch mesh) were used for analyses. These sampling stations were stratified based on the presence or absence of overhanging shoreline vegetation (e.g., fringing mangroves). The seine was deployed along shorelines and on offshore flats inside the estuary and retrieved by hand. Only those samples taken in haul seines above sea grass were used in the analyses.
In order to develop standardized indices of annual average CPUE (catch per haul) for gag from Florida estuaries in the Gulf of Mexico, a delta-lognormal model (Lo, 1992) was employed.

Results:
The results, including the standardized index and index variance are summarized in Table **5-4.** The relative index in compared to other fisheries-independent indices in Figure **5-3**

Length frequency histograms of gag collected from Florida estuaries from the Gulf and Atlantic are reported in SEDAR10-DW-30. Gag from Gulf Florida estuaries had a mean standard length (± standard error) of 187 (± 2) mm (N = 1369).

Utility:
The group recommends the use of the FMRI Florida estuaries index, applied to the appropriate age classes.

5.3 RESEARCH RECOMMENDATIONS:

1. Develop a suitable method to correct species misidentification between black and gag grouper on a trip by trip basis. This issue will be of particular concern when assessing black grouper. The catches of gag grouper misidentified as black is likely a substantial proportion of reported black grouper landings.

2. We recognize that many valuable and well designed fisheries-independent sampling programs have been under funded or discontinuously funded, resulting in low sample sizes, variable sampling effort (in time and space), discontinuous series, and poorly stratified designs. The group ***strongly recommends increased funding toward*** developing and maintaining fishery-independent sampling programs, and stresses that quality indices require continuous funding over meaningful time periods (ideally decades).

3. It was proposed that the index working group examine the possibility of including environmental variables in computation of indices. Variable discussed included wave height, sea surface temperature, surface currents and hurricane impact. The group recommended that, when possible, environmental factors should be considered in future standardization procedures. The group also recognized that other model parameters, particularly the spawner-recruit relationship might be directly influenced by environmental variables, and recommended further consideration of this topic.

4. The group recognized the need to quantify changes in catchability over time. Many stock assessments use catch-per-unit-effort (CPUE) data under the assumption that there is a linear relationship between CPUE and abundance. Indeed, much of the work done to ‘standardize’ catch rates represent adjustments designed to account for nonlinear behavior of catch rates relative to resource abundance. However, there could be features in the data that could not be adjusted for by these standardization procedures due to lack of detail. For instance, an un-quantified systematic increase in efficiency over time could, in a fishery in which there is a declining stock, underestimate the rate of decline, leading to a condition termed hyperstability in the abundance index. On the other hand, there could also be tendencies over time wherein targeting shifts away from the resource leading to a hyperdepletion in the index relative to resource abundance.

   Recommendation: To address these concerns, the SEDAR10 index of abundance working group and the DW plenary recommend the use of an assessment model structure that can accommodate a nonlinear (for example, power-law) relationship between CPUE indices and stock size. Yet we recognize that there is likely to be insufficient information to estimate such a nonlinear relationship since at least one additional parameter must be estimated per abundance index (wherein some non-linearity is hypothesized to occur). Therefore, we recommend that sensitivity analyses that fix the nonlinear parameter(s) at plausible values be conducted to show implications of such assumptions.

Table 5-1. A summary of catch series from the Gulf of Mexico available for the SEDAR10 data workshop.

Fishery Type	Data Source	Area	Years	Units	Standardization Method	Size/Age Range	Problems	Recommended
REC	Headboat	Eastern Gulf	1986-2004	Number per angler-hour	Stephens and MacCall, delta-lognormal	Pending	Address changes in selectivity and catchability	YES
REC	MRFSS	Gulf excluding Texas	1981-2004	Number per 1000 angler hours	Trips are included based on guild composition, delta-lognormal		Address changes in catchability	YES
COM	Longline	Eastern Gulf	1990-2004	Biomass (lbs per hook)	Delta-lognormal	Length distribution from SEDAR10-DW-23	Address changes in selectivity and catchability	YES
COM	Handline	Eastern Gulf	1990-2004	Biomass (lbs per hook-hour)	Stephens and MacCall, Delta-lognormal	Length distribution from SEDAR10-DW-23	Address changes in selectivity and catchability	YES
Fish. Ind.	SEAMAP Video Survey	East Gulf	1993-1997, 2002, 2004	Number (video minimum count)	GLM on binomial model (Presence/Absence Index)	Length distribution from SEDAR10-DW-12.	Gaps in time-series	YES
Fish. Ind.	SEAMAP Video (Copper Belly)	East Gulf	1993-1997, 2002, 2004	Number (video minimum count)	GLM on binomial model (Presence/Absence Index)		Gaps in time-series	Possibly: Could be used to index plus group or males.
Fish. Ind.	NMFS Longline Survey	Gulf	1999-2004?				< 50 gag observed during entire time series	NO
Fish. Ind.	Otter trawl survey	Eastern Gulf	1991-1999				Inconsistent sampling coverage (temporally and spatially).	NO
Fish. Ind.	FMRI Estuarine Sampling	Eastern Gulf (FL coast)	1996-2004		Delta-lognormal	Length distribution from SEDAR10-DW-30.		YES
Fish. Ind.	SEAMAP Trawl Survey	Gulf of Mexico					< 10 gag observed during entire time series	NO

Table 5-2. Pros and Cons for each index as identified by the SEDAR10-DW indices of abundance working group.

Fishery Dependent Indices

Recreational Headboat (*Recommended for use*)

Pros: Relatively long time series (1986-2004)
Consistent
Cover complete area
Large sample size
Large proportion of effort
Non-targeted for gag

Cons: Influenced by regulatory changes
Lacks discard rates until 2004
Variability in fishing practices at vessel level
Catchability may vary over time (Changes in catchability will be estimated in the assessment model)

Issues Addressed:
Possible shift in fisherman preference-addressed using Stephens and MacCall (2004) approach
Change in average trip length over time (accounted for in GLM)

Commercial Indices – Handline and Longline (*Recommended for use*)

Pros: Complete census of fishing trips
Covers broad geographical area
Continuous, 15-year time series (1990-2004)

Cons: Self-reported data
Catchability may vary over time (Changes in catchability will be estimated in the assessment model)
Variability in fishing practices at vessel level

MRFSS (*Recommended for use*)

Pros: Long time series
Complete area coverage
Only FD index that includes discard information (AB1B2)

Cons: Species misreporting issues for black and gag
Should consider changes in catchability.

Table 5-2 (continued). Pros and Cons for each index as identified by the SEDAR10-DW indices of abundance working group.

Fishery Independent

SEAMAP (Trawl Survey)

Gulf of Mexico (Not recommended for use)

Pros: stratified random sample design
Adequate regional coverage
Standardized sampling techniques

Cons: Only captured 4 gag since program inception (1970's)

SEAMAP (Video Survey) (Recommended for use)

Pros: stratified random sample design
Adequate hard bottom coverage
Standardized sampling techniques

Cons: Gaps in time-series. (Includes: 1993-1997, 2002, 2004)

FMRI Estuarine Survey (Recommended for use)

Pros: stratified random sample design
Adequate estuarine coverage
Standardized sampling techniques

Cons: Small number of estuaries sampled. May not represent abundance of entire stock.

NMFS Longline Survey (Not recommended for use)

Pros: stratified random sample design
Adequate regional coverage
Standardized sampling techniques

Cons: Fewer than 30 specimens observed (1981 – 2004). Gear/Survey design does not permit adequately sampling of gag grouper.

Otter Trawl Survey (Not recommended for use)

Pros: Sampled gag

Cons: Opportunistic sampling – not random
Inadequate regional coverage
Some years, sampling occurred at only one location.

Table 5-3. Summary of available fisheries-dependent indices with coefficients of variation.
A) Commercial Indices: CMHL = commercial handline; CMLL = commercial longline

Index Name	**CMHL:1990-2004**		**CMHL:1990-2000**		**CMHL:2000-2004**		**CMLL:1990-2004**		**CMLL:1990-2000**		**CMLL:2000-2004**	
Size Range	>508 mm		>508 mm		>610 mm		>508 mm		>508 mm		>610 mm	
Relative (Scaled to 1)?	YES		YES		YES		YES		YES		YES	
Weight/Numbers	Weight		Weight		Weight		Weight		Weight		Weight	
Units	Lbs/Hook_Hour		Lbs/Hook_Hour		Lbs/Hook_Hour		lbs/hook		lbs/hook		lbs/hook	
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1981	-	-	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-
1990	0.538	0.117	0.653	0.138	-	-	0.850	0.450	1.264	0.332	-	-
1991	0.380	0.110	0.466	0.134	-	-	0.562	0.463	0.850	0.331	-	-
1992	0.477	0.099	0.576	0.122	-	-	0.452	0.606	0.706	0.417	-	-
1993	0.761	0.062	0.926	0.078	-	-	0.624	0.251	0.976	0.180	-	-
1994	0.595	0.064	0.731	0.084	-	-	0.355	0.326	0.541	0.232	-	-
1995	0.741	0.061	0.891	0.078	-	-	0.499	0.278	0.744	0.202	-	-
1996	0.867	0.053	1.041	0.069	-	-	0.586	0.208	0.878	0.154	-	-
1997	0.927	0.052	1.129	0.067	-	-	0.585	0.210	0.875	0.154	-	-
1998	1.524	0.047	1.831	0.061	-	-	1.029	0.157	1.529	0.120	-	-
1999	1.064	0.048	1.289	0.063	-	-	0.780	0.181	1.184	0.136	-	-
2000	1.130	0.049	1.466	0.070	0.741	0.083	1.014	0.160	1.454	0.170	0.592	0.329
2001	1.543	0.047	-	-	1.088	0.075	1.832	0.110	-	-	1.046	0.154
2002	1.510	0.048	-	-	1.072	0.075	1.752	0.112	-	-	0.994	0.161
2003	1.257	0.048	-	-	0.893	0.076	1.951	0.104	-	-	1.114	0.148
2004	1.686	0.048	-	-	1.206	0.075	2.128	0.097	-	-	1.254	0.134

Table 5-3 (continued).

B) Recreational Indices: HB = headboat; MRFSS = Marine Recreational Fisheries Statistical Survey

Index Name	**MRFSS**		**Headboat:1986-2004**		**Headboat:1986-1989**		**Headboat:1990-2000**		**Headboat:2000-2004**	
Size Range	Pending		Pending		Pending		Pending		Pending	
Relative (Scaled to 1)?	YES		YES		YES		YES		YES	
Weight/Numbers	Numbers		Numbers		Numbers		Numbers		Numbers	
Units	Fish/1000 angler hours		Fish/Angler Hour		Fish/Angler Hour		Fish/Angler Hour		Fish/Angler Hour	
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1981	0.987	0.414	-	-	-	-	-	-	-	-
1982	0.435	0.456	-	-	-	-	-	-	-	-
1983	0.835	0.471	-	-	-	-	-	-	-	-
1984	0.303	0.599	-	-	-	-	-	-	-	-
1985	1.182	0.392	-	-	-	-	-	-	-	-
1986	1.062	0.342	1.140	0.156	0.978	0.293	-	-	-	-
1987	0.284	0.376	1.317	0.119	1.205	0.219	-	-	-	-
1988	0.322	0.388	1.057	0.147	0.95	0.284	-	-	-	-
1989	0.439	0.385	0.993	0.157	0.866	0.315	-	-	-	-
1990	0.692	0.397	0.720	0.177	-	-	0.691	0.33	-	-
1991	0.525	0.372	0.597	0.218	-	-	0.606	0.36	-	-
1992	0.466	0.340	0.718	0.214	-	-	0.705	0.354	-	-
1993	1.182	0.324	0.826	0.179	-	-	0.836	0.297	-	-
1994	1.575	0.319	0.836	0.187	-	-	0.868	0.303	-	-
1995	1.504	0.313	0.853	0.2	-	-	0.866	0.307	-	-
1996	1.303	0.322	1.350	0.113	-	-	1.331	0.182	-	-
1997	0.972	0.315	1.327	0.11	-	-	1.339	0.176	-	-
1998	1.966	0.303	1.260	0.121	-	-	1.262	0.197	-	-
1999	1.647	0.301	1.237	0.115	-	-	1.258	0.185	-	-
2000	0.938	0.307	1.048	0.151	-	-	1.239	0.23	0.915	0.386
2001	0.740	0.310	0.778	0.208	-	-	-	-	0.88	0.327
2002	1.457	0.299	0.825	0.209	-	-	-	-	0.94	0.326
2003	1.594	0.299	1.039	0.155	-	-	-	-	1.102	0.273
2004	1.589	0.301	1.078	0.144	-	-	-	-	1.163	0.27

Table 5-4. Summary of available fisheries-independent indices with coefficients of variation.

Index Name	**SeaMAP Reef Fish Video**		**SeaMAP Video (Copper Belly)**		**FMRI Florida Estuaries**	
Size Range	425-975 mm		?		50-400 mm	
Relative (Scaled to 1)?	YES		YES		YES	
Weight/Numbers	***Presence/Absence***		***Presence/Absence***		Numbers	
Units	Proportion Positive		Proportion Positive		Number/Haul	
YEAR	-	-			-	
1981	-	-			-	
1982	-	-			-	
1983	-	-			-	
1984	-	-			-	
1985	-	-			-	
1986	-	-			-	
1987	-	-			-	
1988	-	-			-	
1989	-	-			-	
1990	-	-			-	
1991	-	-			-	
1992	-	-			-	
1993	0.663	0.424	1.244	0.403	-	
1994	0.513	0.528	0.844	0.586	-	
1995	0.446	0.361	0.670	0.497	-	
1996	0.879	0.288	0.758	0.457	1.134	1.134
1997	0.932	0.310	0.544	0.574	0.318	0.318
1998	-	-			0.232	0.232
1999	-	-			0.620	0.620
2000	-	-			0.441	0.441
2001	-	-			0.708	0.708
2002	1.587	0.190	0.964	0.371	3.291	3.291
2003	-	-			1.791	1.791
2004	1.980	0.186	1.977	0.297	0.466	0.466

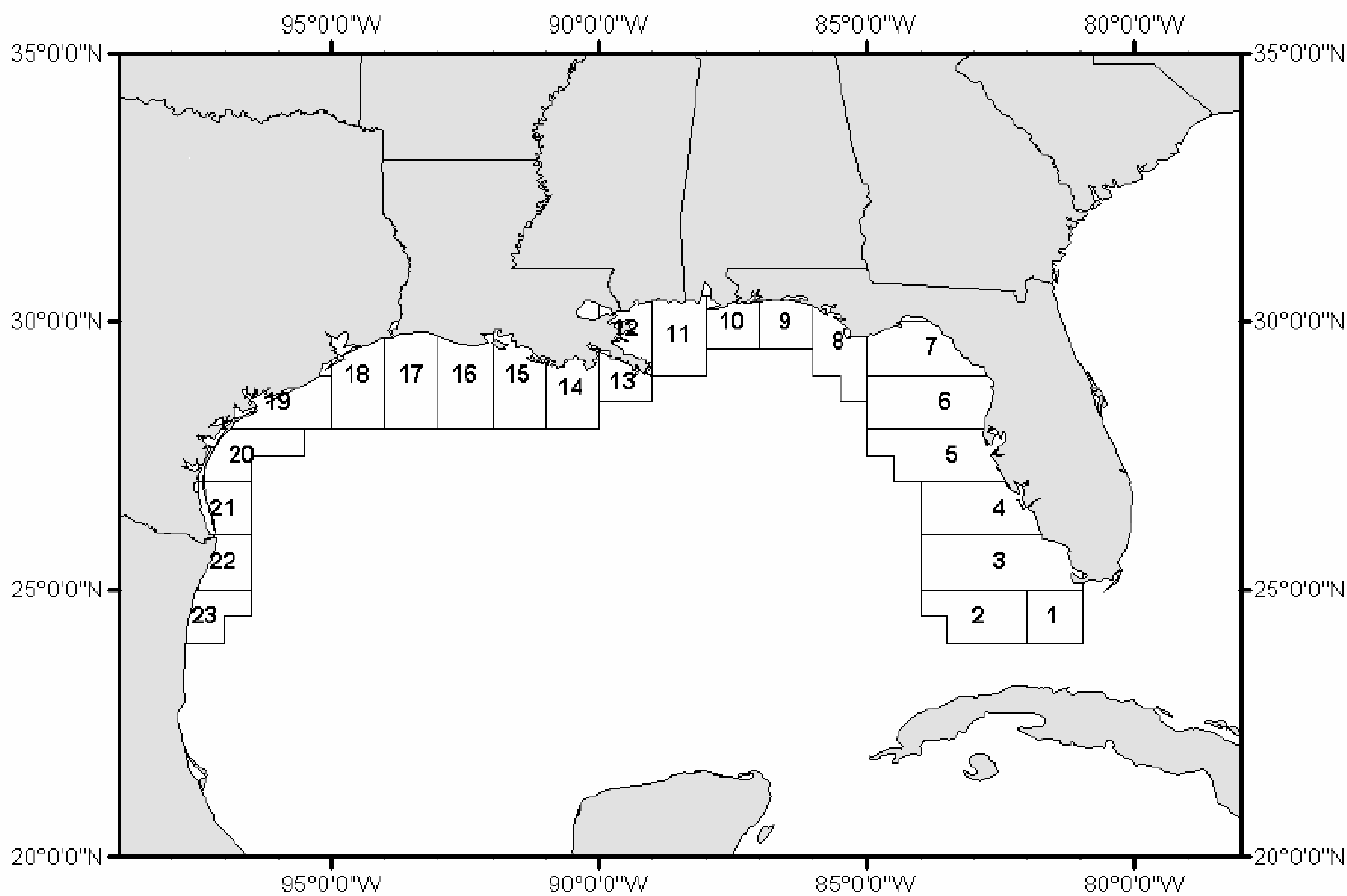


Figure 5-1. Shrimp statistical grids used to identify fishing areas in the U.S. Gulf of Mexico.

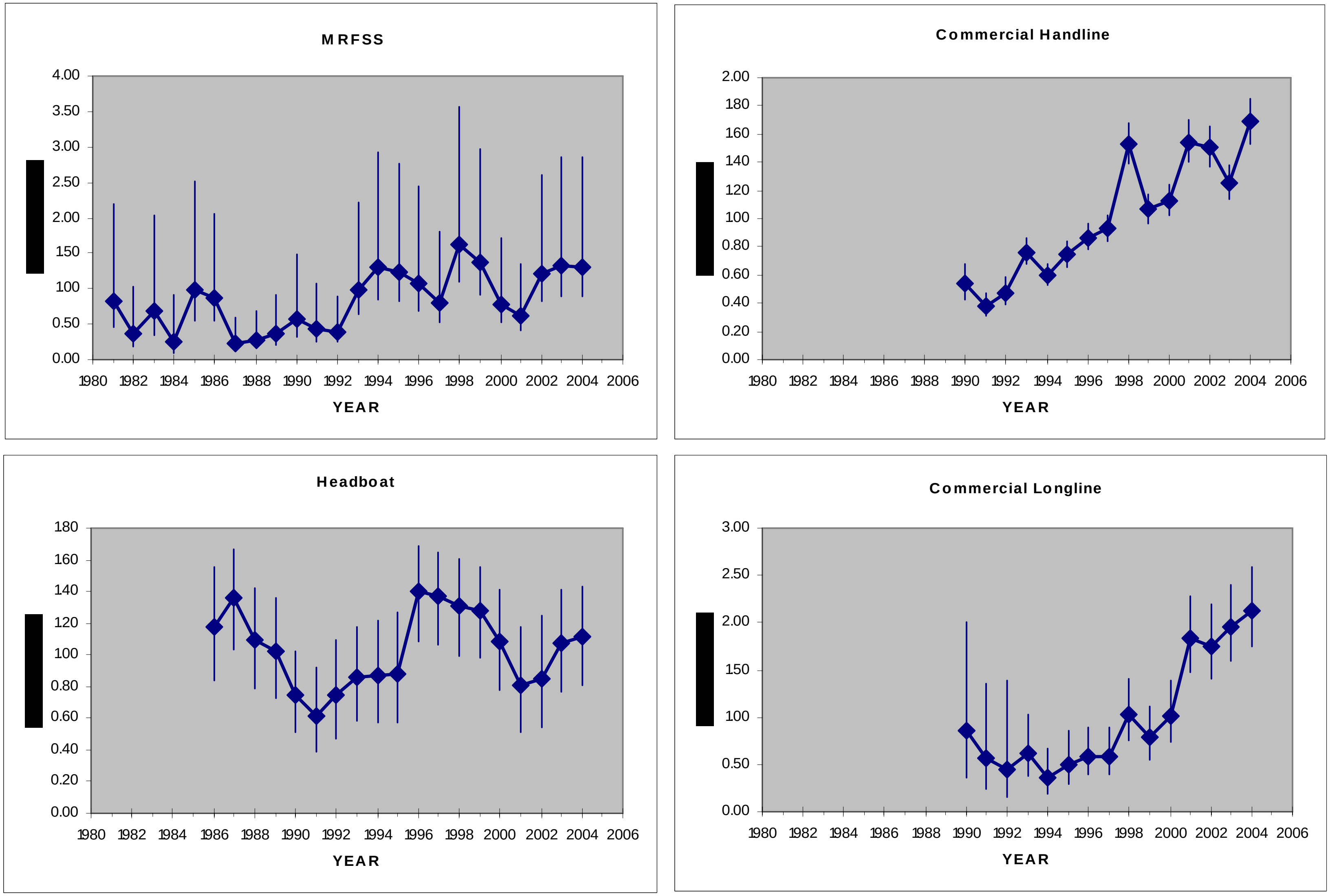


Figure 5-2. Fisheries-dependent indices with 95% confidence intervals.

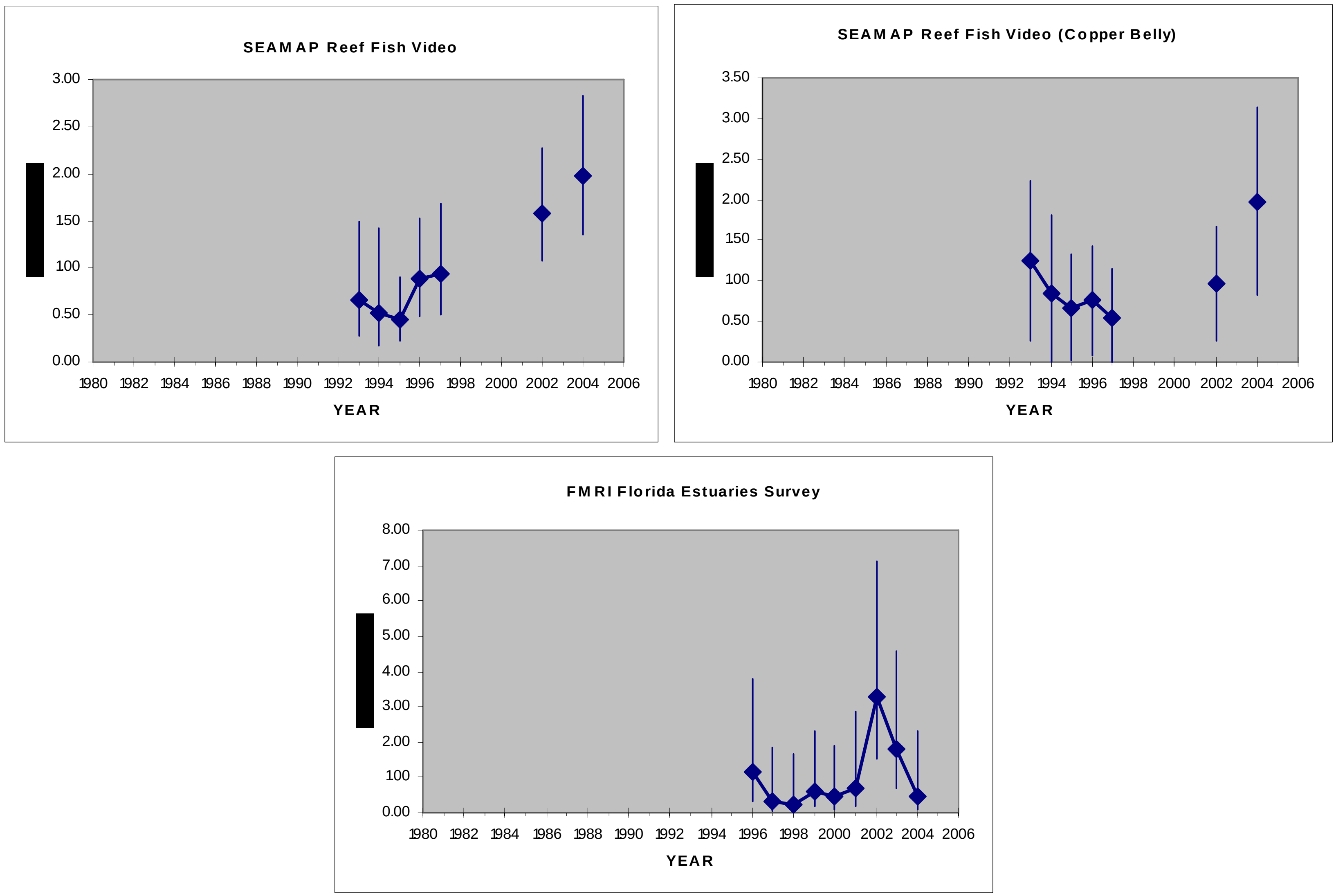


Figure 5-3. Fisheries-independent indices with 95% confidence intervals.